VGS
National

VGS

*NATIONAL

Electric Light

ASSOCIATION.

FOURTEENTH CONVENTION.

MONTREAL, CAN.,
September 7th, 8th, 9th and 10th, 1891.

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Marsden J. Perry, of Providence.
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ORDER OF BUSINESS.

MONDAY, SEPTEMBER 7th, 1891.

FIRST SESSION, 3 P. M.

1. Addresses of Welcome.
2. Responses.
3. President's Address.
4. Announcements.

MINUTES.

OPENING OF THE CONVENTION.

The National Electric Light Association began its Fourteenth Convention at the Windsor Hotel, Montreal, Canada, September 7th, 1891. The President, Mr. C. R. Huntley, of Buffalo, N. Y., took the chair at 3 o'clock, P. M., and called the meeting to order.

ADDRESSES OF WELCOME.

BY PROFESSOR H. T. BOVEY.
MAYOR MCSHANE.
SIR DONALD A. SMITH.
SIR WILLIAM J. DAWSON.
ALDERMAN CLENDINNING.
HONORABLE JUSTICE WURTELE.
EX-MAYOR BEAUGRAND.

The President then introduced Prof. H. T. Bovey, of McGill University, Chairman of the Citizens' Executive Committee of Montreal, who addressed the Convention as follows:

PROFESSOR BOVEY: *Mr. President, Officers and Members of the National Electric Light Association of the United States:* It devolves upon me, as President of the Citizens' Executive Committee, to offer you a very hearty welcome. It is no little pleasure to have this opportunity of meeting and making the acquaintance of so many of the foremost promoters of electrical

science. We sincerely hope that this Convention will be full both of instruction and enjoyment. We feel sure of the instruction, as that depends upon you; as to the enjoyment, we trust that the entertainments provided in the programme will prove agreeable diversions. Gentlemen, I again wish you a hearty welcome. I have now the honor of calling upon His Worship, the Mayor of Montreal, the Honorable James McShane, who will now address you. (Applause.)

ADDRESS OF MAYOR McSHANE.

Mr. President, Ladies and Gentlemen: When my friend, Mr. Bovey, who just sat down, said that he would introduce me to the audience, and that I would make an address, I think he made a misstatement. I am here as the Mayor of Montreal, and I have but a few words to say to you. Some few months ago, Mr. Corriveau, a native of the city of Montreal, a French Canadian, called upon me one day at the City Hall, and asked me, as Mayor of the city, if I would, in my own way, endeavor to give him some encouragement to ask your body to make Montreal your next place of meeting. At that time I gave him a letter, and I believe that Mr. Corriveau (I do not see him here to-day) has only done his part. I know that there was opposition, and I think that St. Louis, and other places in the United States, had sought to take you there, but Montreal has succeeded in bringing you here, and now, in the name of the citizens of Montreal, I offer you a hearty and sincere welcome. (Applause.) I am sure that the citizens of Montreal will do what they can to make your stay here as pleasant and agreeable as possible. I am not going to speak of the great good that your Association has done, and will do in the future, because there are some gentlemen upon this platform, gentlemen who are a credit to any country from which they may come, who will speak to you upon that subject. But I can assure you that if I understood all the facts I might make a humble effort to say something to you upon the question; but I would sink into insignificance when you hear

the gentlemen who are to come after me, and who will speak to you upon the great subject which you are here to consider. Therefore, I will just content myself with saying to you again that you are most welcome among us, and that the people of the city of Montreal will do all that they can to make your stay with us as agreeable as possible. (Applause.)

ADDRESS OF SIR DONALD SMITH.

Mr. President, Officers and Members of the National Electric Light Association, Ladies and Gentlemen: You have already heard words of welcome from the President of the Citizens' Association, and also from His Worship, the Mayor of Montreal, spoken in more appropriate terms than it would be possible for me to use. My own words are not required to give you a hearty welcome, but I do assure you, for my fellow citizens and for myself, that we are delighted to have you with us, and that it gives us the greatest satisfaction to find that you have honored us by coming here on this occasion. I do assure you that we appreciate very highly having you amongst us. Nothing can be of more benefit, nothing can tend more to induce cordiality between the peoples of one nation and another, than such conventions, such comings together, such communings, as we are to have here on this occasion. We hear occasionally of such things as a union, and there may be different views as to whether it may be beneficial or otherwise, I have no doubt there are such in the United States, and also in this country. But, be that as it may, I am one of those who believe that a coming together, as on this occasion, of the peoples of different countries, and especially those who are neighbors together, as we are, and who have such constant and such great relations with each other in trade, and in every respect, cannot but clear away many of those cobwebs and many of those ideas which we have had of each other, and which were entirely erroneous. (Applause.) And I am sure

that the welcome which you will have here from the people of Montreal will be as sincere, as earnest, and as cordial, as it would be possible that any welcome could be. As we shall have the pleasure of meeting again this evening, I believe, amongst others, I may then be with you and see the great advance that has been made in this science of electricity, see how, by the power of man, it can be controlled; and that, although, when left to itself, it is capable of doing injury such as we cannot calculate, yet, when under proper restrictions, it is capable of almost turning the world upside down in every thing that is for the benefit of mankind, even so should we be in welcoming such gentlemen as you, sir, and those who have come here, not only to interest, but to instruct us; and I will only again, before sitting down, say that you have a most cordial welcome from the citizens of Montreal, and that we only wish to know how we can make pleasant to you, in the best way in our power, your visit amongst us on this occasion. (Applause.) But, before sitting down, I would say that we have had communications from His Excellency, the Governor-General of the Dominion, Lord Stanley, which express very great regret at being unable to be here to join in doing honor to you to-day, on this occasion and this evening, but he has made a point of arranging his engagements so that we shall hope for his presence at the banquet which our citizens will have the honor of tendering you on Thursday (Applause.)

ADDRESS OF SIR WILLIAM DAWSON.

Mr. President, Ladies and Gentlemen of this Association: In tendering you a cordial welcome, not only from McGill University, but, I think I may say also, from all teaching bodies in the Dominion of Canada that are interested in the practical and applied sciences, I only recognize what all of our universities and colleges are now bound to recognize, that in the presence of an association like this we are in the presence of a great, growing, and coming profession, and one which, more, perhaps, than any other, has served to bring to the notice of the world the great advantages that may arise from the prosecution of the physical sciences. Your science was prosecuted for a long time before much was known of its practical applications, but in the present day, as you know, and in the last few years, this great subject of practical and applied electricity has not only come to be something wonderful in the growth which it has presented with regard to its own special developments in telegraphy, in lighting, and in other matters of that kind, but also because it has been, young though it is, lending a hand to older scientific professions. We find now that the civil engineer, the mechanical engineer, the mining engineer, the metallurgist, and the assayist, all of them, are under obligations to the electrical engineer, and it is now extending its hand—this young giant which has grown up amongst us—to all the older branches of our scientific professions, and it is making, more than ever before, the subject of the physical sciences one which is attracting the attention of the community,

and young men are endeavoring more and more to qualify themselves to enter professions of this kind. That gives us in our university a good reason, and gives all universities everywhere a good reason, for recognizing such an association as this by offering it a cordial welcome ; and which we in McGill University are entitled to do the more especially on this occasion, because you honor our academical town with your presence. That we consider to be a great honor ; and not only so, but you come at a time when we in McGill University are expecting, at the next session, through the liberality of one of our great benefactors here in Montreal, to be able to establish for the first time, in a thorough and efficient manner, a course of electrical engineering (applause), and in which we hope to have many of our young Canadians emulate the skill and success which you, gentlemen, and others on the other side of the line, have so eminently shown in this great and rising profession. And so, on behalf of McGill University, and, I may say, in behalf of all educational interests in Canada, I have the greatest pleasure in offering you a kindly welcome, and in saying that we shall do all that we possibly can to make your stay here as pleasant and as profitable as possible. (Applause.)

ADDRESS OF ALDERMAN CLENDINNING.

Mr. President, Ladies and Gentlemen of this Society: A hearty welcome has been tendered to you by the leading men of our city—His Worship, the Mayor, the President of our great educational institution, and by other gentlemen—and it remains merely for me, as an Alderman, in behalf of the Aldermen, to tender you a most hearty welcome. I need not say that Montreal feels especially honored by your presence. I think when it is borne in mind that the great cities of your own country competed for the honor of your session and that you gave Montreal the preference, Montreal ought to feel especially proud of your coming, and I say, in behalf of the Aldermen, and also, in so far as I may speak, in behalf of my fellow citizens, that I think nothing will be left undone to make your stay amongst us as pleasant as it can be. You represent a science which has changed the entire face of the commercial world. There is probably nothing that has contributed so largely in this respect within the last century, or that has so changed the entire condition of things in the commercial world as has electricity. I think that you gentlemen on the other side of the line have astonished the world with the usefulness which you have proved can be brought out of electricity. I am sure that you have but just opened the door, and I do not think that anybody can tell what is coming in the future. I am sure that there are a great many more purposes which you are going to serve by and by. I wish you all success, and I tender you a very hearty welcome. (Applause.)

ADDRESS OF HON. JUSTICE WURTELE.

I can only say that I repeat the welcome that has been already extended to you. I did not expect to be called upon to make any remarks. I merely came in because I thought as many as possible of our citizens should turn out to do honor to this occasion. (Applause.)

ADDRESS OF EX-MAYOR BEAUGRAND.

Mr. President, Ladies and Gentlemen: I really do not know that I have much to add to what has been already said. So much of welcome has already been tendered you that nothing is left me to say upon the subject, were it not that I probably represent here the French element. I presume that you are aware that the City of Montreal, with a population of 250,000, has 150,000 French, which we call a majority at election time. I am sure that the French population of Montreal are very happy to join their friends of other origins in tendering you a hearty welcome, and, so far as the French are concerned, I suppose that I do not need to recall to technical men like those who are present, that there are in the history of French science the names of such men as Vesey and Jablochoff, and others, who have done a few little things in electricity, and have done them in such a way that their services are recognized and appreciated by Frenchman and Americans alike. This has been done in the past, and I am sure it will be in the future. I am sure that on this occasion of your visit here you will meet none but smiling faces among the French Canadians of the City of Montreal, and I assure you once more of their very hearty welcome, a welcome from all, irrespective of nationality. I doubt not that in your exhibition every citizen of Montreal will not only see, as Sir William Dawson has said, a very interesting exhibition, but many things that are very instructive; and that your presence here, and your visit to our city, will be the occasion of giving us great pleas-

ure, and of teaching us things that we do not know quite so well as our brothers across the line, the Americans, because they are practical men, who are applying the sciences so as to get money out of them, and their reputation is made in that way. So far as electricity is concerned, there is probably no country in the world that has gone so far as they have done. I have had occasion, in traveling out West for the last few years, to observe this; and, wherever I have gone, even away out in the Rocky Mountains, I have found your appliances there, making money, lighting the people, and advancing civilization. There is no doubt at the present moment that the great power of the future is electricity, and we are very happy to see here the vanguard of Americans who come to represent it in our city. We tender them a hearty welcome once more. (Applause.)

ADDRESS OF ALDERMAN CUNNINGHAM.

Mr. Chairman and Members of the Electrical Association, Ladies and Gentlemen: I can only endorse what has been said by the previous speakers, and what, to my mind, they have said so well. I am a very poor authority on electrical matters, notwithstanding I have sense enough to know that electricity will revolutionize our machinery, and that, instead of horse and steam power, electricity will be the motive power. As I said before, I am no authority on electricity, but perhaps I might say a few words of explanation as an Alderman. I am pleased to know that this meeting takes place in our city, but, as an Alderman, I am sorry to say that many of our streets are not in such a condition as we wish them to be. (Laughter.) Yet, to our visiting friends I will say that they can see that we are doing a great deal in the way of permanent pavements, and that in a short time our city will be in keeping with modern cities. Ladies and gentlemen, when this meeting is over, and when it is a thing of the past, I hope you will have every reason to congratulate yourselves on having selected the City of Montreal for the meeting. And perhaps it might not be out of place if I were to say, on behalf of the citizens, that they owe a debt of gratitude and of thanks to the members connected immediately with this Association (I mean Professor Bovey, Mr. Corriveau, and others) who have worked to bring this meeting here and to make it a success. As far as I am concerned, I will do all that I

can, in order to make your visit among us agreeable, and I hope that when you return to your homes you will carry with you pleasant recollections of the City of Montreal. (Applause.)

ADDRESS OF MR. RICHARD WHITE.

Really, Mr. Chairman, I can only say "ditto." So much has been said, and so well said, that I think you would much sooner listen to the addresses of the members than to any further word of welcome. I do not think that I can add anything to what has been said, and I can only express my hearty sympathy and accord with the sentiments expressed by others.

RESPONSES.

By President Huntley.
United States Consul Knapp.
Hon. E. A. Armstrong, *and*
Mr. Erastus Wiman.

President Huntley: *Mr. Chairman, Ladies and Gentlemen:* For the first time in its history the National Electric Light Association meets on other than its native soil. Yet, even in so doing, it but adds new evidence to the feeling in the breast of every electrician that his art is foremost among the influences tending to promote human intercourse and break down the walls of separation. Coming, as do our members, from every State in the Union and the Dominion of Canada, and representative as they are of all the varied agencies and methods for the distribution of electric light and power, it affords me the greatest pleasure to acknowledge in their name the fraternal welcome with which we have all been received, and the lavish hospitality that makes us at home in this noble Dominion and in its magnificent City of Montreal. (Applause.)

From the fact that the invitation was so cordial, and that the reception has been so warm, I can but infer that the Association enjoys here an intelligent appreciation of its work, its objects and its aims. Permit me to say, therefore, that the Association asks for itself, during the coming week, a kindly tolerance of its technical papers and discussions, hoping that the large exhibit of electrical apparatus of the latest and most perfected character may make amends for the somewhat abstruse nature of

its proceedings. If the earnest and practical quality of our dealing with the great questions of electricity shall in any wise stimulate electrical work in Canada, and lead to the utilization of its great water powers and coal beds in light, locomotion, power and heating, we trust it will be accepted as, at least, some acknowledgment of the manner in which we have been so generously greeted. (Applause.)

I have the honor of calling upon United States Consul General Knapp to say a few words to us in behalf of the United States.

UNITED STATES CONSUL KNAPP: *Mr. President and Members of the National Electric Light Association, Ladies and Gentlemen:* It affords me great pleasure to be present and participate in the exercises of this afternoon, and I am sure that you need no words from me, after those which have been uttered by the several gentlemen who reside in the City of Montreal, to assure you of a most hearty welcome, and I am certain that I can speak for the members of the Electric Light Association in saying that should it ever be the lot of citizens of Montreal to visit their cities, they will give you a loyal and elegant greeting. But I assume that it is with the gentlemen who have spoken from the City of Montreal, as it is with me, one of the best thoughts connected with your coming here that you have come in a most gallant way, that you have brought with you those whom we all like to see, the ladies, and so I will say for the City of Montreal and her citizens that we bid, also, a loyal and royal welcome to the ladies who come with this National Electric Light Association. The associations of this hour are suggestive of two-fold congratulation; first, congratulation to the City of Montreal that she has the privilege of having so royal a guest and one so worthy of her hospitality as this National Electric

Light Association; an Association, which, although young in years, embraces in its membership men who have become famed in their works, men whose success in the great fields of science and invention have become the proud heritage of mankind; an Association which has for its purpose the development of one of the grandest sciences known in this nineteenth century, a science which in its development and in its application is for our good, ministering to the wants of humanity, and also ministering to the wants of nations.

But while I congratulate the citizens of Montreal in having so royal a guest, I may also congratulate you who come from the United States in having a host so royal as is the City of Montreal. Let me say to you as visitors of my own nationality that you realize that it is a city justly famed—a city where mercantile and manufacturing industries tell the story of prosperity—a city made beautiful and interesting by historic spots, by noble monuments, by stately edifices, where churches of every denomination point toward Heaven their spires of faith, and where institutions of learning like McGill College rise and shed their rays of light through this Dominion, to other nations and to the world. You will also find it a city whose citizens always have the hand of welcome, the word of greeting, and the heart of friendship for the representatives and for the people of the United States. And so I say that this is an hour for mutual congratulations and felicitations, and as I join in them and, in one sense, bid you welcome, in another sense, if I may be permitted, I will express to the citizens of Montreal your gratitude for this royal greeting, and I beg to express the hope that as your stay will be pleasant, so your Convention will be one of profit to you as individuals, and of advantage to the great science you represent, and through it all we shall realize better than ever before

that we are all citizens of two countries which are, and will continue to be, royal friends. (Applause.)

JUDGE ARMSTRONG: To you, Mr. Chairman, the chief magistrate of this city, to this Committe, who so kindly and so cordially bid our Association welcome, I am called upon, by the man whom we have learned to obey, to respond. I can promise you in advance that the response you will receive from everyone wearing the ribbons will be much more cordial, much more appreciative, much more expressive, than any words that I can use, because it will be an active gratitude. Mine is none the less sincere, none the less hearty; and, as I have listened to these cordial words that have come to us, I have realized again, and more fully, I think, than ever before, what electricity does. It has been called the great annihilator of space, that thing that reaches its destination as soon as it starts. It is evidenced here to-day that it can annihilate State lines; that with it no peoples are known, only one people; that no communities are known, only one great family. We, therefore, appreciate most heartily the welcome you have given. You have asked why we should leave the cities of the States, where we peculiarly belong, it is claimed, and come here. Do you know who your representatives were whom you sent down to invite us to come? If you do know them, as we have learned to know them, you will know that we could not help coming. (Applause.) They promised us well, but we have already received much more than they ventured to promise. Had they told us what you have told us here to-day, we would have begun to suspect that their promises were too fair; the allurements were too great, and we would have been afraid to come. They just told us enough to induce us to come, and we are glad that we came.

I would not dare, I suppose, across the line—I have heard you refer to some *line* here—I would not dare, I suppose, across the line, to refer to the thing that Sir Donald Smith referred to, but I imagine I can venture to do it here, because I have understood since I have been here that there are no politics whatever in the Dominion. (Laughter.) The McKinley Tariff Bill was referred to, and I heard a great many ladies complaining when they were crossing that line, and I would like to say to them that the examination was not on account of the McKinley Tariff. (Laughter.) I find that Montreal is all that has been claimed for it. I stood upon Mount Royal and overlooked as fine a scene as ever my eyes beheld. It was indeed a *Royal* view. Spread out before me was a scene of marvelous beauty. We saw the magnificent buildings, the great churches, the industrial establishments. We saw here and there the evidences of stupendous enterprise, and we learned that this is indeed a city of great progress and a place of great enterprise. But I was greatly surprised that you had not learned one thing over here so well as we could teach you across the line. I heard your ex-Mayor say, in speaking for the French Canadians, that 150,000 was a majority of 250,000. Now, we can find many ward politicians down our way who can show you how that majority can easily be overcome. (Applause.) We do not count majorities in that way at all, and I am surprised, with all your enterprise, with all your advancements, that that is one thing that you have not yet grown on Canadian soil.

This welcome, though, my friends, that we have received—as I saw the earnest expressions on the faces I knew, as men can know, that these words of welcome came from the heart. I looked down here at this badge and I saw the two flags, distinct and separate, standing

out clear, but under the button bearing our name there was some sort of connection, it was completed there. The flags stand distinct, representatives of distinct States, and yet they meet at a common centre, they meet at a common point, they have a point of contact where they are all interested. They meet around this circle where there is no people known, no government known, only the good of mankind as mankind. (Applause.)

And glad am I to meet with such an assembly ; glad am I to take part in such a community. When such assemblies gather, when such communities meet, when such interests are brought together, then you may know that all the dickering of politicians, that all the selfish enterprise of sovereigns or sovereignties, that everything that may be done by individual ambition or individual avarice, must give way to that thing that speaks so well for common humanity—that one enterprising feeling, that one desire, that one earnest hope to benefit the people of the whole world and advance them all as one community. I, therefore, particularly appreciate the welcome—the Canadian welcome—that is given to this Association. I particularly appreciate the fact that we are here assembled ; and, while I never mean to forget, nor do you wish me to forget, that my allegiance is owed somewhere else, I am proud that upon this great continent there is a people of such enterprise, such energy and such ambition, as I have been permitted to see in the few hours that I have been here. I rejoice with you, my friends upon this Committee, on the promising future that you see for Canada. I rejoice, because what does you good will do us good, what is good for us will be good for you, and what is good for you will be good for us. Our community of interest is great. I am glad that we can meet here with you, and I feel, in the language of the German doctor, whom I heard speak at

one of the International medical conventions; he was speaking, and he desired to express how he enjoyed being there. Seeing his own flag from his window, he said it made him feel very *homely*; and the words that I have received from you here, and what I have seen floating over the hotel where we stop—the banner of our country—seeing it over McGill College—seeing all these things has made me feel very *homely*, and when one of your aldermen came out and, after joining in the welcome, began to apologize for your streets, I felt entirely at home. (Laughter.) We have been greatly libeled as a people, and will you permit me to make this inquiry? It is said that as Americans we want everything, and I am inclined to think that some of this Committee may have had that same notion in mind when they came and extended this welcome, because they did not propose to leave anything to be asked for, they have given us the whole thing, and I only question in my mind whether or not it was because of that libel upon us as a people. I trust that that may not be so.

Now, one word more. One of the speakers congratulated us because we brought the ladies along with us. That proves conclusively that he has not been at our electrical conventions heretofore, and I am sorry to say that it proves that he does not know anything about the science of electricity. Ask any one of these bright electrical engineers—and you will observe that most of these electrical engineers are young men—ask any one of these engineers what he could do without an attachment. Ask him to tell you how necessary it is to have both positive and negative currents, and ask him also about the essential character of a switch. (Laughter.) Ask him about any of these things, and then never again

will it be noted as a matter of mark that ladies are attending electrical conventions.

I speak not merely formally when I say to your Worship, to the Chairman of this Committee, and, through them, to the citizens of Montreal—I speak not merely formal words when I say that in our hearts we deeply appreciate this welcome. A more cordial welcome this Association has never received; a more hearty reception has never been given; and, coming at this place, at this time, and under these circumstances, we deeply appreciate it.

We have gone about your beautiful city—and I want to say right here that I went to ten churches yesterday, and I understand I have yet 66 to visit—as we go about your beautiful city and see the good that you have here, and see the enterprise that you have here, and see the works of beneficence and benevolence that have been inaugurated here; as we see all these things and receive such warm words, such hearty greetings as you have brought us, we promise you that in so far as in us lies we shall make this Convention the banner convention in the history of the National Electric Light Association.

MR. ERASTUS WIMAN: *Mr. President, Ladies and Gentlemen:* I could not resist the temptation to spend a few hours in Montreal to act in a double capacity. A resident, and a member of this Association in New York, I wanted to come here and partake of the hospitality of the city in which I spent some of the happiest years of my life, and in which, perhaps, I am better known than any man that ever left it. In another capacity, I want to come as a Canadian, and to say a few words of welcome to the men with whom I have been associated in the latter years of my life in the great country on the south—to say how glad we Canadians are to see you here among us. There is nothing in the

world that is so productive of good as the mingling of these two races together. If they met more often, if they understood each other better, if they comprehended the great good that is in both, better conditions would prevail and a larger charity and a better trade and a greater progress would come in everything. But I come to-day in this double capacity simply to testify, as I think no other Canadian can testify, to the Canadians themselves what a marvelous brood of young fellows has sprung up in the last five years in connection with electrical engineering and electrical propulsion. It seems to me as if a new creation had dawned on the world. I want to say to my young Canadian friends what a beautiful thing it is to think that out of the great cities like Chicago, St. Louis, Boston, Providence, New York, and all over, there should come such a representative group as we have here to-day; so representative of the great growth of science, such wonderful achievements as they have been the instrumentalities of performing. I am glad to stand before you in this double capacity—first, as a member of this Association, to thank the gentlemen for the hospitality extended to us, and secondly, as a Canadian, to thank you for coming to my native land. I think I can say to Americans here that great as has been the progress of electricity in the United States, the Canadians have shown an appreciation of it greater almost than that of the people of the United States themselves. I doubt if any system in the world is more perfect than the system of telephones in Montreal and Toronto. I doubt if any city in the United States has such a development of that marvelous instrument as these two cities have. As to the telegraph service, somewhat connected with it as I am, I believe I may say this, that there is a larger mileage of wire, a greater number of offices, and a greater number of messages transmitted,

in proportion to population, in Canada than any other country in the world. I can say this, too, that a lower rate, a cheaper price for transmission, is uniformly afforded in the Dominion of Canada than in any other country in the world, taking distance into consideration; so that in telephony and telegraphy, electricity has found in this continent, in this Canada of ours, its greatest development. I would like to say to Canadians, though, that in certain things a greater progress has been made in the the United States than here; and that is one idea I had in asking to speak to you to-day, namely, that I should draw your attention to the marvelous growth in the United States of the use of electricity in the street railway. It seems to me that no one thing has grown with such rapidity as the value of real estate wherever there has been an electric railway introduced. I know that it is alleged that the United States have, more than any other country, the power to create wealth. I know that last year we produced in that country eight millions of bales of cotton which sold at a price of $400,000,000; a sum greater than all the gold mines in the world produced in five years. I know we mined ten million tons of iron and I know we produced this year an enormous crop of wheat. These are great accumulations of wealth, but they sink into insignificance compared with the increased value in real estate wherever an electric railway is promoted. There has been a greater advance in Boston in the value of real estate by the establishment of the West End Railway than Boston ever made by any other influence. I saw in Minneapolis and St. Paul—those two wonderful rivals that we see struggling to get ahead of each other all the time—a greater growth in values and a more perfect system of communication than by any other means possible; so at Tacoma; so at Spokane. It is strange that in Montreal, of all cities in

the world, that is only beginning to be realized. I want to impress Montreal, and also other cities, with the great advantage that comes from this marvelous method of propulsion. I want to impress on my friends in Canada the advantage that the electric system has in the transmission of power. I was in Boston on Friday, and stood in one station which had a potential of 20,000 horse power; a power so vast as to be almost beyond human comprehension. Fancy, if you can, 20,000 horses under one cover, saddled and bridled and ready for a start. Fancy the forces that were latent in that potential under that roof; and yet, away off in some distant avenue, by some delicate wire it was necessary only to touch the button and the power did the rest. So it would be in Montreal. It seems to me I do my duty as a former citizen of this place, and still somewhat interested in it, in drawing the attention of the residents here to the fact that they possess potentialities of power almost beyond any city in the world. In the great Rapids above them and below them are forces, which, if applied by electricity, would be of the greatest advantage. I know of no city that has such enormous facilities for the creation of electricity as this city has. I know of no place in which power can be transmitted so perfectly and completely as in this city; so that a delicate current transmitted by a wire might work a fan in a sick room, and in the next block might lift a trip hammer; so that a sewing machine, or a half a dozen of them, or 50 of them, or a factory, could be run from the St. Lawrence and Ottawa by the transmission of this power. An optician might grind the most delicate piece of glass in a small lathe before him, and even the running of a sewing machine and the rocking of a cradle might all be done by electricity. I think I can see in the marvelous growth of that power that the French race will even in-

crease by the facility of rocking the cradle by electricity. Perhaps when that day comes the census will tell a different tale. I hope it will. At any rate, we want something to stimulate this country to grow a little faster.

I have great gratification, indeed, in believing that you will have a most joyful time. So far as the city itself is concerned, I have the belief that your presence here will stimulate and draw attention to this question of, not only having every street equipped with electric railroads, but making every ripple on the rapids contribute to the wealth of the city. I cannot but think that the great progress that electricity has made, and your presence here, will bring popular thought and popular opinion to bear on this question of the use of this tremendous force that now lies idle, so far as its transmission is concerned. If that should occur, it would all be attributable to the fact that the National Electric Light Association held its meeting in the city of Montreal. Montreal has facilities for manufacturing greater than any other city in the world; it has got raw material at its hand; it has got the cheapest and best labor; it needs only the touch of electricity to make it the greatest city and the greatest country under the sun. (Applause.)

President C. R. Huntley then addressed the Convention, as follows:

PRESIDENT HUNTLEY'S ADDRESS.

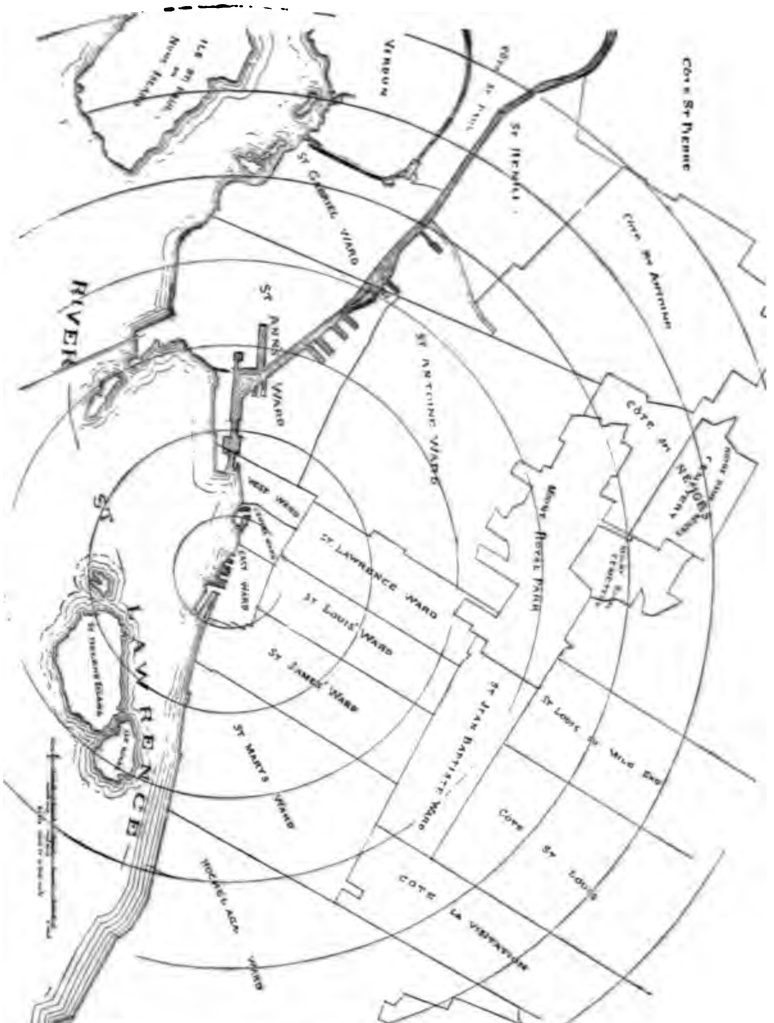
Gentlemen: My predecessors in this chair have seen the Association advance in strength and worth, outliving trials and vicissitudes, to emerge on a wider, larger field of usefulness and opportunity. I do not believe there is another industry in the world which has passed through such quick stages of evolution as ours, and become so soon established in popular favor and general prosperity.

But we must not assume that, because electric lighting has set its feet upon the rock and laid its deep foundations, nothing more remains to be done, save to pursue the policy and practice of the past. On the contrary, I deem it necessary to say here that my own responsibilities as a central station manager compel me, as never before, to be watchful of the tendency of conditions and inventions in the art, so that I may in any degree profit from my own hard won experience. If, as central station men, we are to secure adequate return on the investment committed to our care, it becomes us in every way to study closely all the ideas that will give higher efficiency of plan and higher economy in operation. There was a time when some of us expected to grow rich out of abnormal prices. To-day there is not one of us who does not know that his hopes of dividend lie wholly in the skill with which the best business ability and the soundest engineering are applied to the work in hand.

I take it that it is now pretty well recognized among intelligent station managers that the day is past when they can limit themselves to one class of service or apparatus to the exclusion of all others. To obtain the fullest measure of success and the largest return from the capital invested, they must be ready to supply any demand made upon them. As a result, the successful station even to-day is gradually assuming a composite character. This compositeness is manifesting itself, first, in the variety of apparatus, as a result of the selection of the machines best adapted to a given class of work, and independent of any particular system. One cannot help seeing in this change from early practice a step towards increased efficiency of station operation, as well as a good reactive effect upon the manufacturers of apparatus. We are thus all placed on a common basis of competition. But, besides a compositeness in detail, signs are not wanting that no one method of distribution from a central station can, in the large majority of cases, be adequate to the demands that are made upon us, and that to meet them in a manner to insure a profitable business, requires a flexibility and variety in methods of distribution, the full extent or which is to-day hardly recognized. To reach the full limit of its usefulness, the central station should avail itself of methods which, I believe, will finally resolve themselves into what may be called the "Zone System" of distribution.

The idea embodied in this zone system can best be explained, perhaps, by taking a concrete, practical example, and for this purpose the present occasion makes the City of Montreal an interesting one. Setting aside, for the moment, the possibility, and even the probability of the transmission of electrical energy to the city from the power obtained at Lachine Rapids, we will assume a

station erected at the water front of the harbor, as indicated on my diagram. It will, I believe, be granted that



up to within a distance of one third mile radius the three wire, low tension, direct current system of distribution answers fully every requirement of simplicity and econ-

omy; and hence, if, with the station as a center, we draw a circle having a radius of one-third mile, we shall have a "zone" supplied in the most economical manner for every class of light and power apparatus now familiar to us.

Coming to the districts beyond the first zone, we are necessarily obliged to have recourse to higher potentials for the feeders (and the selection of the proper potential is a matter of simple calculation; we may, for the sake of this argument, call it 500 volts). Continuing in this way, in steps of 500 volts, successive zones, half a mile across, might extend, in the aggregate, to several miles without reaching the limit of potentials which have been found to be perfectly feasible in practice.

In the example, no reference has been made to the nature of the current employed or to the method of local distribution. Evidently, we may readily resort to the alternating system, employing converters to reduce or raise the potential; or to the direct current, reduced from high to low by motor-dynamos. Either one is perfectly practicable. Perhaps some of our new school of electrical engineers will show us how to use the same circuits for both alternating and direct currents.

But, whatever sytem be employed, I deem it proper to record here my conviction that the most economical way to distribute the current to the consumers at the point of delivery, is by low pressure conductors, in contradistinction to the plan now generally in vogue of giving each customer a converter of his own, or, in the direct system, a separate motor-dynamo. I need not here enlarge upon the train of reasoning which has led me to this conclusion, but I may remark that I am strengthened therein by my own experience in Buffalo, where we are now introducing gradually 200 light converters, and replacing the smaller ones heretofore employed. Nor do

we propose to stop there, but expect to install converters of still higher capacity, distributing the current to a number of customers by low pressure mains centering at the large converters. As addressing myself to practical men, I need not refer to the fact that it costs practically no more labor, etc., to put up a 200 light converter than it does to put up a 10 light converter, while the initial cost per light is less in the case of the larger converter. In these conclusions I am only recommending for large American areas what, I believe, is now recognized abroad by Ferranti and others, whose work, like our own, will eventually lead to the establishment of large converter sub-stations, from which low tension wires will supply the surrounding districts.

The allusion made to the motor-dynamo system for converting the direct current from high to low potential, may to some appear nothing more than the citing of a possible method, in view of the existence of the alternating system, well tried and already at hand. But, without wishing in the least to detract from the merits of this system, which has probably done more to popularize electricity than any other, I cannot, as a practical man, conceal from myself the fact that, taking everything into consideration, the low tension, direct current system of distribution is the most flexible within its area, and serves the greatest variety of purposes. I do not think that any one can successfully contradict the assertion that to-day no other system can, with equal efficiency, take care of arc and incandescent lamps, motors, large and small, storage batteries, electric heaters, etc.

In making this statement I desire to be understood as referring to the present condition of the art, the only condition which, as practical men, we ought to consider in matters of this kind; but I hope the time will soon come when the same can be said of the alternating

system. There are still other methods which suggest themselves by which the "zone" system could be effectually carried out, but those indicated are sufficient to demonstrate the idea I have endeavored to convey.

After the intelligent station master has decided upon the nature of his apparatus and the initial capacity of his station, his most important consideration is the allowance to be made for future growth. Look back, some of you, and recall the mistakes made which were brought about by the enormously rapid growth of the industry. I need not go out of my own experience for such an example. Less than two and a-half years ago we erected in Buffalo a new station considered far too large for even the most extended future growth. Some of my colleagues shook their heads. Yet to-day it is being worked to its fullest capacity and provision will soon have to be made for more facilities.

What, then, may be asked, shall we determine upon as the unit time limit of growth for which provision should be made? Shall we build our stations sufficiently large to take care of the demands of five, ten, or twenty years hence? This is a most serious question, and one, to my mind, as important as the selection of the proper station apparatus itself. I note the erection of several stations abroad, and some here, designed to supply the demands of fifteen or twenty years hence. Without wishing in any way to detract from the laudable enterprise and faith exhibited by the promoters of these stations, a calm survey of the past, present and, probably, future condition of the art leads me to believe that the setting of so long a time limit as fifteen or twenty years is inadvisable. I need not remind you in detail of the changes in methods and apparatus which have been effected during the last five years, by which the efficiency and output of our stations has been increased, and, if to

this we add the fact that already new methods, such as those pointed out by Mr. Tesla, may at any time increase the present lamp capacity of our stations five and ten fold, I think we may be justified in placing five years as the limit of time, to make provisions beyond which may involve expenditures, the benefits of which may not be realized.

These are matters we are endeavoring to settle for ourselves. It is to our interest to settle them. So, too, with the underground question—but there we have gratuitous advice, assistance and abuse, to such an extent that less progress is made than in any other part of the work. We all want to put our wires underground where the number is so great as to make them unsightly or unwieldy, and not a few of us have been parties to experiments now written off to profit and loss. As soon as the time arrives when every house has its wiring as a matter of course, just as now it has piping for water and gas, it will be comparatively an easy matter to lay down comprehensive underground systems. But at the present time, the customers for current are scattered, and not continuous. The man with enterprise enough to take electric light and power soon moves into a larger store. His successor does not want the service, but gropes along with kerosene, or spoils his goods with gas. Cutting out disused underground services is an added risk and expense, and 10 lights could be installed on overhead circuits for $10, where with underground the cost would be $50. It follows that in any city—Buffalo, for example—we shall not make one underground connection where with overhead wires we shall have made 20. Now, are the public or are we the greatest losers? The public, I think. It is as unreasonable, in most instances, to demand underground wires as it is to expect every railroad to make every crossing above or below grade. But for

our overhead wires, America would not be to-day the great land that it is of electrical triumphs; and, while I hail with delight every advance in the solution of the underground problem, I hope long to gladden my eyes with the sight of a pole well set and a wire well strung.

Another stirring question of the hour is that of municipal ownership. Now, it has been taken for granted that electric light men are against this plan, tooth and nail. How absurd that notion is. Because we represent the latest development of invention and industry, we certainly do not forfeit our pride as citizens, nor lose our interest in the advancement of social science. It would, in fact, be difficult to find a more progressive, well-known body of men in America to-day than they who have put their money and energies into electric lighting. They are neither crusted nor cranky, but when any movement has been started for the betterment of the communities in which they live, some of them have been at its head. Now, is it strange that such men should object to the confiscation of the properties they have built up and that are beginning to pay? Is it strange that they should ask for these new theories in social economy to be tried on something else first? Many of them have grave doubts as to the accuracy of the figures that are supposed to prove that municipal plants pay. Others of us have great objection to any taxation, the proceeds of which are to set the municipality up in a commercial business; others, again, believe that the best results are reached in any industry when it is freest from political influences, and is left to the uplifting and perfecting impulses of individual enterprise.

I believe that the most conclusive answer we can make to the sophistic arguments of an ill-disguised socialism, presenting itself in this municipal ownership scheme, is

to give the very best service possible at the lowest rates compatible with fair profit. Some of the prices we now obtain are so low as to exclude any profit at all, especially when repairs and reconstruction are considered. But here, again, we may help ourselves out by native wit. Every company in the ranks of this Association ought to ascertain for itself, at regular intervals, just how it stands as an industry. A good deal of apparatus in use is decidedly inefficient. Overhaul it. If necessary, throw it out and put in better. Above all, adopt a good system of book-keeping. It has been the source of much gratification to me to see in the pages of one of the leading electrical journals, recently, a most valuable series of articles on central station management and finances, by Mr. H. A. Foster. I trust that every electric light man will read those articles, if, indeed, he has not already done so. The subject is admirably treated from the practical standpoint, and it is impossible not to derive good from the many hints and suggestions, while the various forms and blanks shown may be adopted with much benefit. Electric light securities are to-day far from enjoying the esteem in financial circles that they deserve. This is due, in a measure, to speculative investment and to over-capitalization in the past. But it is also attributable, very often, to the poor system of accounts employed, and I am glad to see the subject thus receiving attention. If we know what our current costs, we know what we can sell it for, and unless that information is obtainable from our office books, engineering will go for naught and capital required for new work will stand aloof.

In conclusion, I would urge that the Association determine upon meeting only once a year. Even if it were not impossible to recover in six months from such overwhelming hospitality as we are now the recipients of, I

believe that the time has gone by when half-yearly meetings were necessary. Once in twelve months is often enough for us to come together for the comparison of our experiences and the report of further refinements in the details of the industry. The mere fact that frequent reunions are no longer necessary is in itself a hopeful sign, for it tells of stable and settled conditions of activities that now require our presence at home pretty well the year round.

Gentlemen, I thank you for your attention, and I trust that your deliberations in the coming week will be characterized by the same earnestness which has characterized them in the past.

ANNOUNCEMENTS.

The President then read an invitation from McGill University to the members to visit the library, museum and buildings of the University; an invitation from the Art Association of Montreal to visit their gallery; an invitation from the Quebec and Levis Electric Light Company to visit its works at Montmorency Falls; an invitation for a trip up the Richelieu River, and an invitation from the Harbor Commissioners to join them in a trip up the Lachine Rapids. The President added that there were also several garden parties, which had been announced and which were printed in the souvenir and would appear upon the daily bulletins.

On motion of Mr. Seely, the invitations were received and filed, and a vote of thanks extended.

THE PRESIDENT: When the invitations were sent out, knowing that we would come to Montreal, the Executive Committee instructed its secretary to invite as a body the American Institute of Electrical Engineers, the New York Electrical Society, and the Society of Electrical Engineers, of Brooklyn. I have their responses here, and the invitations have been accepted.

We are also in receipt of a letter from the Director-General of the World's Fair, authorizing Mr. Hornsby to represent them here in connection with the Fair. I believe he will be here to-morrow and will present the subject to you when the matter of the World's Fair comes up, for which we have a committee.

I wish to urge upon every member to be present at our meetings. We have many interesting papers and

there is ample time for pleasure in the afternoon, and we should have every man, whether an associate or an active member, on the floor during the discussion beginning at ten o'clock and lasting until two, and I hope that to-morrow morning, and every other morning, you will all be here.

There is no further business before us.

The Convention then adjourned until September 8th, at 10 A. M.

ORDER OF BUSINESS.

TUESDAY, SEPTEMBER 8th, 1891.

SECOND SESSION, 10 A. M.

1. Report. Committee on Amendments to the Constitution.
   GEO. B. SHAW, Chairman.
2. Report. Committee on Relations between Manufacturing and Central Station Companies.
   E. A. ARMSTRONG, Chairman.
3. Report. Committee on Data.
   A. J. DE CAMP, Chairman.
4. Topic. "World's Columbian Fair."
   J. A. HORNSBY, of Chicago.
5. Report. Electrical Section of Committee on Data.
6. Report. Committee on Legislation.
   E. A. ARMSTRONG, Chairman.
7. Report. Committee on Underground Conduits and Conductors.
   M. J. FRANCISCO, Chairman.
8. Report. Committee on Safe Wiring.
   A. J. DE CAMP, Chairman.

SECOND SESSION.

The Association met pursuant to adjournment, Tuesday, September 8th, 1891, at 10 A. M.

THE PRESIDENT: The first thing in order this morning will be the reading of the report of the Committee on Relations between Manufacturing and Central Station Companies, of which Mr. Marsden J. Perry is chairman.

MR. ARMSTRONG: Mr. President, there is a little error there; we have been transposed. I am chairman of that committee, and Mr. Perry is chairman of the Committee on the World's Columbian Exposition. Before reading the report of the Committee on Relation Between Manufacturing and Central Station Companies, I will, with your permission, present a letter that Mr. Shaw, of Eau Claire, Wis., has sent me from the special committee appointed at the last Convention on Amendments to the Constitution:

REPORT OF COMMITTEE ON AMENDMENTS TO THE CONSTITUTION.

EAU CLAIRE, WIS., Sept. 3, 1891.

Mr. Chas. R. Huntley, President National Electric Light Association, Montreal, Que., Canada.

DEAR SIR: The Special Committee on Revision of the Constitution, appointed by yourself, pursuant to a resolution adopted at the Convention of the National Electric Light Association held in Providence, R. I., in February, 1891, have had under consideration the question of revision of the Constitution, and beg to report as follows:

That, in the opinion of the committee, the fundamental features of the Constitution, and the general plan involved, should not be modified or changed, and that, while the Constitution itself is susceptible of improvement in questions of detail, and, if diligently amended, may be made more symmetrical, yet, as the Constitution has not been in existence a sufficient length of time to give it a fair trial, it is our opinion that any changes, amendments or modifications at this time are undesirable; and we recommend that no amendments to the Constitution be submitted at the forthcoming Convention. Respectfully submitted,

GEO. B. SHAW,
E. A. ARMSTRONG,
Committee on Amendments to the Constitution.

Mr. Shaw said that he was detained by engagements, over which he had no control, and could not be here. I move that this report be received, and that the committee be discharged.

MR. WEEKS: I second that motion, and, with the permission of the Chair, in so doing, I want to say that I am very glad that this committee has reached this wise conclusion. I take it that that State, that corporation, that association that is continually tinkering with its original law, is in a bad way; and that our Constitution should be allowed to stand, at any rate, until it has had that seasoning of time which will enable us to determine wherein changes are necessary. When the Constitution of the United States of America was adopted, you may remember of having read in history that various objections were raised to it. It was even held by some that under that Constitution there would be nothing but ruin ahead for the States. But those croakers were not listened to; the Constitution was given the seasoning of time that it required, and it was found that it needed but comparatively few simple amendments.

I have great pleasure in seconding the motion of Judge Armstrong.

THE PRESIDENT: You have heard the report of the Committee on Amendments to the Constitution. What is your pleasure? If there is no objection, the report will be received.

The next business is the report of the Committee on Data, by Mr. A. J. De Camp, Chairman.

MR. ARMSTRONG: Had I not better first present this report of the Committee on Relations between Manufacturing and Central Station Companies?

THE PRESIDENT: Yes.

MR. ARMSTRONG: I read the following report:

REPORT OF THE COMMITTEE ON RELATIONS BETWEEN MANUFACTURING AND CENTRAL STATION COMPANIES.

The Committee on Relations between Manufacturing and Central Station Companies beg leave to report:

As this committee reported at the last Convention, so it reports to-day. No new matter has been brought to its attention. One of its members asked yesterday, "What excuse can we give for its previous existence, or make for its continuance?" We have all realized the possibility of great good through this agency, but there has been but little attempt to utilize it. Unless something is to be accomplished in this field that demands the most thoughtful care and attention (and is the one point where our interests are to-day involved), the committee ought not to be continued.

Very respectfully,

E. A. ARMSTRONG,

E. R. WEEKS.

THE PRESIDENT: You have heard the report of the Committee on Relations between Manufacturing Companies and Central Stations. What is your pleasure?

MR. WEEKS: I move that the Committee on Relations between the Parent and Sub-Companies be instructed to formulate a definite plan of procedure for the protection of central station companies, and to prepare the necessary articles of agreement, and report the same to this Association in executive session at its next Convention.

MR. FRANCISCO: I second the motion.

THE PRESIDENT: You have heard the motion of Mr. Weeks, seconded by Mr. Francisco. Is there any discussion?

MR. WEEKS: Mr. President, I fully and heartily concur in what was said by Judge Armstrong in regard to the importance of the work before this committee. In my opinion, along the line of work in the mind of this Association when this committee was appointed, lies the salvation of the central station interests of America, and I think, Mr. President, that the time has come for some plain talk on this subject. I propose, therefore, to briefly review the situation. You will remember that the early history of electric lighting was phenomenal, in that people were so ready to believe everything that was promised for the new industry, and so confident in its value as an investment. The wonderful achievements of Edison, Bell and others in telegraphy and telephony did much to pave the way for the introduction of the electric light. Such was the attitude of the public mind that companies were readily organized for central station work, and the extravagant statements of parent companies as to the performance of machinery of their manufacture, were received with a credulity not very complimentary to the wits of investors. Manufacturers of apparatus claimed for it a high efficiency (in one case even as high as 105 per cent.!), and declared that, with the exception of brushes and commutators,

which might need renewing every few years, it was practically indestructible; nay, it was even held that it would improve with use, and they set their prices so high that these qualities seemed assured. They guaranteed to purchasers: First, high efficiency; second, patent protection; and third, exclusive rights in their respective territories. They assured investors that the new light could be produced cheaper than gas; and, in order to compete with gas, and increase the demand for apparatus, they advised continual reductions in rates of service. Companies were speedily organized in the larger cities, and capital smiled on electric light investments. It was soon found, however, that the various so-called systems of electric lighting were extremely crude, and the apparatus so short-lived that investments must be increased to meet the demands for improvements and renewals, for which parent companies made little, if any discounts. Still, so confident were the local companies of the ultimate success of their ventures, and so blindly credulous of the good faith of manufacturers, that additional capital flowed in, and parent companies were enabled to enlarge their producing powers and increase their dividends. In the course of time it began to appear that the second claim of parent companies, in consideration for which local companies had paid such high prices, could not be maintained. Patent protection was not given, and pioneer enterprises saw their fields invaded by apparatus employing the very devices for which they had paid so liberally upon the assurance that those devices were controlled by the guarantors. Meantime, capital was beginning to discover that electric light investments were often bottomless abysses. The crudities and imperfections of apparatus; its short life, necessitating constant renewals; its extreme delicacy, necessitating frequent costly repairs; and the cut-throat competition instigated

and supported by rival manufacturers using practically identical apparatus, affected public confidence. Most of the profitable fields had been occupied, and, although the electric light had demonstrated its desirability and its superiority over gas, the rate of service was necessarily much higher, owing to the greater cost of plant, operation and maintenance. As parent companies found themselves with immense producing powers, and without sufficient demand to employ them, the more powerful ones began to purchase the business and factories of the weaker, presumably to clear the field of competitors ; but the temptation to violate their compacts with their pioneer local companies proved too strong. It was observed that few of these systems were withdrawn from the market ; that their purchasers had placed them in charge of their most experienced men, and, after fortifying weak points by their own special devices, intended to sell this apparatus at greatly reduced prices in fields already fully occupied by their own apparatus which had been bought at high prices by companies to whom they had promised protection of all kinds. What treachery could be more abominable towards those who had borne the brunt of the new industry's struggle for a foothold ; who had literally enriched parent companies by their own bleeding ; who had created the demand for the apparatus that parent companies had to sell, and who, through their own dearly bought experience, had shown inventors and manufacturers wherein their apparatus could be improved and cheapened. But worse treachery followed. The most outspoken enemy of the electric light has always been gas. The gas companies were wealthy corporations who had fully occupied the field of lighting for many years, and had fattened upon the profits of the industry of which they had a monopoly, and which required a plant comparatively simple in construction,

easily and cheaply operated and maintained, and so employing raw material that its residual products were made to yield a handsome revenue. When the electric light entered the field, it labored under the enormous disadvantages of costly, complicated, and imperfect apparatus, unknown operating expenses and depreciation, and no by-products. Yet the gas interests, recognizing the new light as a formidable rival, fought it in every way available to a long-established, powerful, and wealthy monopoly. The parent electric companies were bitter in their denunciation of the methods employed by the gas interests in their efforts to prevent the establishment of the new industry; and until their revenues from local companies began to fail, assisted the latter in the struggle in every way which did not seriously affect their pockets. At the present time, Mr. President, the condition of affairs is changed. The gas interests are still opposed to the electric light. But, as this has shown that it has come to stay, gas companies all over the world are preparing for a new effort. They will wage war with our weapons—with cheap apparatus furnished them by our parent companies, they will endeavor to so demoralize the field of electric lighting that legitimate business cannot stand the strain. Parent companies are selling to the gas interests (and they have the effrontery in their advertisements to boast of their success) apparatus that employs the very devices whose exclusive control had been guaranteed to the interests that the new purchasers are straining every nerve to kill. And this is being done at a most critical period, when depreciation is becoming known at its full value, when, owing to the general depression, market values of service are at their lowest, and when there is a strong tendency on the part of municipalities to demand of the electric industries expensive and doubtful changes to curtail their

privileges and reduce their rates. Manufacturing companies are directly and indirectly promoting this tendency, and are inciting municipalities to purchase plants, thus depriving local companies of a profitable service which they themselves have created. To the one hundred thousand stockholders in the local companies of America is chiefly due the establishment of the new industry. They have produced the sinews of war, and by them the battle has been fought and won. From them parent companies have derived the support which has made them what they are. For this veteran service and this timely support, what return do parent companies make? Having possessed themselves of many millions of our hard-earned money, they are now violating their most sacred obligations and betraying us to the enemy. You, Mr. President, like Agricola Senex, in the fable, have nurtured a viper in your bosom. You have created a Frankenstein monster who now turns his hand against you, and I warn you, central station men of America, that if you would save your millions you must prepare to carry the war into Africa with respect both to the gas and to the parent companies. These two interests, with their pronounced porcine proclivities in common, must both be considered in this connection. The gas companies have, not without a certain shrewdness, thought well to concede to us the period of experimentation, believing that, through the treachery of the parent companies, they could easily step in and capture the business when its permanent value became known. After we have paid the score and quaffed the froth, they, like the thirsty soul in Virgil, intend to seize the bowl and drain it to the dregs. But, Mr. President, if to them we seem vulnerable on account of the prices which we have paid for apparatus, let us not forget that they, too, have their "undipped heel." Their plants, also, can

be duplicated at much less than their original cost, and by improved processes their rates can generally be greatly reduced and still leave a larger margin of profit than most of us enjoy. Indeed, the gas field is a most attractive one. For, while gas is fast losing its place as the leading illuminant, it is certain to be the fuel of the future, and fuel will always be more generally and largely used than light. Fuel is everywhere a necessity, while light is largely a luxury. I, therefore, advise every one interested in electrical central stations to investigate the gas business, subscribe for the gas journals, and let slip no opportunity to gather information regarding this great industry.

With regard to the parent companies, I will say that you central station men, who have created these companies, have the power to check their rapacity, and, if need be, to destroy. Your interests are identical. You have a peculiar element of strength in that you do not seek to serve the same customers and can, therefore, never be brought into conflict with one another. Your investments now aggregate upwards of one hundred millions and with stockholders among the best business men, the leading men of affairs in America, you have the power to inaugurate and carry forward a movement which will be irresistible. Why should this army of producers, with their one hundred millions of active and productive property, and their inexhaustible resources, submit to the extortions and treacherous attacks of a few syndicates who are little more than brokers in material, whose *bona fide* investments aggregate about twenty-five millions, and whose factories can be duplicated—yes, and greatly improved upon—for one-half that sum? Let us enter into a compact whereby we will pledge ourselves to purchase apparatus only of those companies who will treat us fairly, and, in case we cannot get such fair treat-

ment, in case we are met by a combination on the other side, let us pledge our united support to a new manufacturing enterprise which will not be slow to enter the field upon this guarantee ; and, Mr. President, as a last resource—if worst comes to worst—let us, on our investment of upwards of one hundred millions, call into a common fund one, five, ten or even twenty per cent., standardize our apparatus, and do our own manufacturing. You, Mr. President, well know that there are already upwards of twelve millions pledged in writing to that movement. Your committee should push this work forward with all possible vigor, as it cannot fail to result in the greatest good to the greatest number. (Applause.)

JUDGE ARMSTRONG : Mr. President, as chairman of this committee, I have listened with a great deal of interest to what has publicly been expressed, and so ably expressed, by my fellow member, Mr. Weeks. Since I have been a member of this Association, this one question has been discussed with more vigor outside the meetings of the Association, and when we have met one another, than any other question, and, indeed, it should be discussed not only outside, but inside, because these very evils that he speaks of are the most dangerous things that we have to encounter in this business in which we are engaged. Now, there should be no conflict of interests, there should be no throat-cutting in this, because it is absolutely essential that we establish firmly this industry. Have any of your companies attempted, outside of your own circle, to place your securities? Have you attempted to do business outside of your own immediate circle—those with whom you are particularly interested? If you have, you have been met by just exactly these things that shrewd business men could see. If we are bound to be subject, not to fair competition,

not to the ruling markets, not to anything of that sort—but if we are bound to be subject to raids, where will it end? How will the business be advanced? How will enterprises be exploited? How can we carry on, as we hope to do, the business in which we, as pioneers, have engaged? It is very natural that if we as lighting companies come into a territory and propose to succeed some other method of illumination—it is very natural that that method of illumination should seek to oppose us. No matter if they realize, as they almost invariably do, that we can give a better thing, better suited for the purpose, do better work in this line, it is not natural that they, representing their stockholders, should sit by quietly and let us take the field. They might as individuals, as citizens, condemn the fact and lament the fact that their interests as stockholders, as directors, as managers of another thing, makes them oppose this advance, but, nevertheless, they will oppose it, and when they can be met with the encouragement, with the assistance, aye, with the direction of those who ought to be the last to encourage them, those who ought to be the first to discourage them—I say when they can be met by that, it is no wonder that our enterprises are hampered as they have been, and as many are to-day, represented here upon this floor. Now, Mr. President, it is not a desirable thing that any of these methods that Mr. Weeks suggests should be engaged in by us as corporations or by us as individuals. Not one of them is to be commended. I will take that back—one of them is to be commended—that we engage to deal with those who will deal fairly by us. That I do heartily commend. But the others I cannot commend, and, as I take it, he does not commend them either. No more does he commend the necessity that there is to build fortifications, to raise armies, to engage in war. No more does he deem

it an advisable thing to take physic, and yet all these things, under given circumstances, are necessary, and, as I understand it, the circumstances are with us to-day, and if we suffer them to go we will be in the position of a State that permits a host to fully arm and equip itself and come against it, while it remains defenseless and unprepared. We will be in the condition of a man who suffers the inroads of disease to come so that there is no possible hope of recovery, no matter how much he may subsequently physic. Let us at this time diet ourselves. Let us at this time prepare, so that encouragement will not be given to those who seek to come against us. As I understand it, Mr. President, when this committee was first appointed, at Kansas City, it was with the idea of formulating some plan—doing something, only, however, because it was supposed that central station men would come to them with suggestions and explanations and experiences, so that we might before this have gone on to prepare against this day that seems now upon us. As I take it, this resolution that Mr. Weeks has offered means that now we as an association, through our committee, shall prepare some definite plan by which, because of its object, we agree firmly to stand, and by which we propose firmly to establish the business of our constituents. (Applause.) I am heartily in favor of taking the most vigorous method, using the strongest possible means that we can employ, firmly to establish our business, and I am more in favor of that from the reason that any such act cannot, by any possibility, hurt any legitimate enterprise. If that be so, no man can condemn what we suggest doing to-day. (Applause.)

THE PRESIDENT: Is there any other discussion on the subject? This is a very important one, gentlemen.

I would call upon Mr. Wilmerding, of Chicago, to say something on this subject.

Mr. Wilmerding: I do not think, Mr. President, that any central station man can differ with Mr. Weeks and Judge Armstrong on this point. We all know what experience some of us have had. Personally, I cannot say that we have suffered very much, and a combination such as has been suggested would take care of the future. That is what we want to look out for. I think that a gentleman present, who has had more experience in this line than I, can say more to the point than I can ; Mr. Francisco.

The President: We would be glad to hear Mr. Francisco.

Mr. Francisco: I am rather peculiarly situated on this question. I have been hauled over the coals for the last two years for this very thing. I have been furnishing light at about one-third the cost of producing it, on account of this kind of guerilla warfare, so that I know something about it from actual experience. I am now, as I was at Kansas City, and as I was at Providence, strongly in favor of this movement, and I hope that the central station men of America will take hold of this as a body, united and strong ; and there is no question in my mind, if they will do that, but that it will succeed, and that they will support themselves without any difficulty. It is not, as I look at it, a warfare. That is not the idea. It is simply self-protection. That is what we are after, and nothing more. We do not want to inaugurate a warfare against the manufacturing companies or the parent companies. That is not the idea. But we want to simply say to them, when we have purchased a thing that we desire to have the right to use it. What we want is protection. We want them to comply with the agreement they made with us, and we want

the power, if they do not do it, to compel them to do it. That is the position that I take in this matter, and the position that all central station men should take. Now, here is a station established. I go to my people asking them to invest money. What object is there, they ask, in investing money? How do we know but what there are going to be three or four parent companies coming in and establishing plants, just as they have done already, and compelling us to keep buying them off all the time? Now, a company that is organized and started in business, especially in places not large enough to sustain two companies—the only object in establishing the rival company is to compel the original company to buy them off, or to sell apparatus to some opposing company. If the second company can raise enough money, they will wipe out the first company, and go on until the parent company comes in and wipes them out. Now, with this arrangement that has been discussed here and was discussed at Providence, there is a united effort. The parent companies and manufacturers understand that it is not for warfare, but simply for self-protection, and that if they deal squarely and honorably with the central station men, they will secure three times the patronage from those central station men that they can get by selling one or two plants to different parties scattered over the country. I have, unfortunately, been drawn into this controversy about municipal lighting, and have been very flatteringly noticed by some of the municipal papers over the country in a way which is not very cheering, but I have got so accustomed to it now that I do not think anything about it. In fact, if I do not see some article in regard to my theories and my crank ideas on municipal lighting in some paper, somewhere, about every day, I think it must be that the matter is falling off, and that the principle of municipal lighting is rather

going backward. But the same principle is involved there that is involved here. A city gets the idea that it can produce light for about half what the corporation can produce it for them. Some parent company goes to the officers of a city and proposes to put in a plant. Now, they are not only going to furnish the city lighting, but they are going to put in lights and do commercial business right in direct opposition to the local company whose capital is invested there, and whose rights that very city has guaranteed by contracting with it to do that business. Now, after they have invested their millions of dollars in that property, this parent company tells the city that it can produce its lights for half of what the local company is charging for them. Now, that is entirely wrong, and this combination of central companies should be made to meet that point right there, whether it is selling to cities, or selling to other opposing corporations; I do not care which it is. They should be met there, and they should be forced to abandon that scheme and to treat the local and present companies fairly and honorably.

Mr. Wilmerding speaks of Chicago. I saw there was a bill introduced into the Illinois Legislature, allowing the City of Chicago not only to produce its own lights, but to furnish commercial lighting all over the City of Chicago in direct competition with the local company there. Now, everybody knows what the result of those things will be. Everybody knows if they can tax you and me to make up the deficiency, that they can wipe out any local company, no matter how large its capital. If the city has the privilege of falling back and taxing the people, of course there is no possibility of competing with them. I trust that this matter will go forward, and that the men of this Convention will

take this thing by the horns and put it in proper shape and carry it forward.

MR. T. CARPENTER SMITH: I have listened with a great deal of interest to Mr. Weeks', Judge Armstrong's, and Mr. Francisco's remarks. I was very much interested in one proposition put forward by Mr. Weeks, where he spoke of forming a company for the manufacture of apparatus. I think that in that suggestion there is a weapon that lies ready to the hand of every central station man. We know that there is enough machinery on which the patents have entirely run out which can be used for electric lighting in an electric light station, referring more particularly to arc apparatus. The one feature in an arc machine which has been used to sell apparatus more than any other, and which has been used by parent companies, one against the other, is that of a good regulator. I have had some little experience—not very much—in arc lighting, and I have found that the best regulator of an arc machine is a good big load. (Applause.) Now, I think that there is not a central station in the country but that has bought and paid for enough patent regulators to take care of all their small circuits—all their cut circuits—and I think if this committee put in the hands of every central station information that would enable them to buy machines which would run their full circuits, and let them keep those for which they have already paid heavy prices to run their cut circuits—that you have got a weapon to bring the parent companies to a sense of what it means to lose nine-tenths of their business at once. I feel that this committee, if it be continued, should look at the matter in that light. It is information of that kind which we want circulated among the central stations. I know station after station that has enough apparatus to do its whole business, which it cannot use, on account

of defects in it—its old apparatus, which could be fixed up and do efficient work, if its men knew how to fix it. But the parent companies tell them it would be necessary to buy new stuff. Advice to buy new material is what they are always met with. What the central station wants is information which will enable it to use its old stuff that it has already bought and paid for. I believe there is enough apparatus to-day in central stations to do all the business for ten years to come without buying another particle from the parent companies. (Applause.)

MR. F. NICHOLLS: I am very much interested in the question at the present time, and I have listened with a great deal of interest to the remarks made by Mr. Weeks and by Judge Armstrong. I must say, however, that I have a good deal of sympathy with the parent companies, because as business men, we all admire a company that is aggressive in pursuit of business, and, while I admire their aggressiveness, I must say that I question the policy of their procedure in these matters. It is far better, it seems to me, to have a healthy, vigorous company in any one locality, than two or three competing companies that are slowly dying of inanition, and who are cutting each other's throats. But it seems to me, sir, that this matter has been so well expressed, that the different arguments have been so well put—that it would be a pity, considering the smallness of the attendance at this meeting, for the rest of the members who have not an opportunity to be present here to-day to have to wait until the minutes of this Association are printed in due form, and, on that account, I beg to move that the discussion by Mr. Weeks, with the remarks of Judge Armstrong added thereto, as taken down by the official stenographer, be printed in the form of a pamph-

let at the earliest possible moment, out of the funds of the Association, and sent to every active member.

MR. SEELY: Is this the final report?

THE PRESIDENT: I will entertain your motion, Mr. Nicholls, later on, after consideration of the report of the committee.

JUDGE ARMSTRONG: In reply to Mr. Seely's question, I would simply say that the committee's report was, that nothing had been offered by the membership of the Association to the committee; and, under the line of its appointment, it did not understand that these various things could be entered into by it. It was to stand more as an arbiter between parent and sub-companies where this question arose, and, while outside there has been the greatest amount of muttering and discontent and feeling, as has been well expressed here to-day, yet so far as the committee is concerned, nothing had come to it. There was no necessity for the parent company to come; it did not care to; it wanted to be let alone. None of the sub-companies seem to understand that they were to bring in their grievances, if they had any, to this committee, and the suggestion of the committee was that, if it should be continued, there should be some definite direction given to it to take the initiative, or else that the committee be no longer continued as one of the committees of this body.

MR. SEELY: This Association need not take any action of the body on this subject, except to receive the report of this Committee and either continue it or discharge it.

THE PRESIDENT: The matter under discussion is simply the report of the Committee, and it is for the body to determine what to do with the report of that Committee.

MR. SEELY: The question before the house——

The President: There is no question before the house, other than the report of the Committee.

Mr. Burleigh: If I understand the matter, Mr. Weeks' motion is before the house that this Committee be continued.

The President: Will you please write out that motion, Mr. Weeks?

Mr. Weeks wrote out and handed to the Secretary the following motion:

"I move that the Committee on Relations between Parent and Sub-Companies be instructed to formulate a definite plan of procedure for the protection of the Central Station Companies, and prepare the necessary articles of agreement, and report the same to this Association in executive session at its next Convention."

(The motion was seconded by Mr. Seely and carried.)

The President: Now, Mr. Nicholls, we will entertain your motion.

The Secretary: Mr. Nicholls' motion is that the report of the Committee, and the discussion thereon, be printed and distributed at the earliest moment.

(The motion was carried.)

REPORT OF THE COMMITTEE ON DATA.

THE PRESIDENT: I will now call for the report of the Committee on Data.

MR. H. M. SWETLAND: In the absence of Mr. De Camp, I have been requested to prepare and submit the following report relative to the Comparison of Economy in the Generation of Power:

MR. PRESIDENT: Your Committee finds an almost universal opinion among managers of electric light stations that it is impossible to record actual expense in generating power for this service, owing to the fact of frequent changes of load, and short and irregular runs. The aggregate coal bills, from week to week, may be compared with the charges made for lights delivered, but whether this aggregate compares favorably with the coal actually necessary to perform this work, or whether it be twice the amount necessary, is often considered an unanswerable question. In most instances where records are kept, the data begin and end with the number of pounds of coal burned and the number of lights delivered, no attempt having been made to record the performance of boilers and engines separately; and, while the data furnished might prove the economical operation of the aggregate plant, they often show a wide margin for waste which may be either in the boiler, engine or dynamo room.

The Committee are, therefore, confronted with this fact: A large majority of the stations do not make records of the performance of their machinery in sufficient detail to be of service in a matter of comparison,

and, while many reports have been received covering fully the work contemplated, sufficient data have not been received to form a complete report that can be submitted at this meeting. The work of the Committee must, therefore, be directed to the encouragement of simple duty tests, and, if we may suggest it, to plain directions for such tests. Until it shall have been made a part of the routine work of a central station to keep these records, the "duty test" will continue to be the "mole-hill mountain" of the management, and the difficulty in making these records will be over-estimated. Once entered upon, the simplicity of the work is apparent, and the management finds this report as indispensable as the others.

In this respect, the work of the Committee has been misunderstood. We do not advocate a Prony brake and engine indicator on every piece of machinery, or a corps of clerks and experts to make instantaneous comparisons of coal with power developed, but we urge that every piece of machinery should be frequently tested, and records of performance made. When we remember that the entire paraphernalia for a test of evaporation of boilers consists of a barrel, a pair of scales, a thermometer, and an intelligent engineer, the simplicity of the work becomes apparent; and when the test once made developes the fact that we are only evaporating six pounds of water where the boiler manufacturers guarantee eleven, the personal advantage of this test is plainly seen in dollars and cents. Many errors creep into the boiler room that are not observed until the test of evaporation stirs up a careful search. Then the boiler settings may be found incorrect, the draft imperfect or not properly regulated, or the firing may be done in such a manner that the coal wasted exceeds the coal used. If this test and the simple test of the amount of steam used in the engine

it an advisable thing to take physic, and yet all these things, under given circumstances, are necessary, and, as I understand it, the circumstances are with us to-day, and if we suffer them to go we will be in the position of a State that permits a host to fully arm and equip itself and come against it, while it remains defenseless and unprepared. We will be in the condition of a man who suffers the inroads of disease to come so that there is no possible hope of recovery, no matter how much he may subsequently physic. Let us at this time diet ourselves. Let us at this time prepare, so that encouragement will not be given to those who seek to come against us. As I understand it, Mr. President, when this committee was first appointed, at Kansas City, it was with the idea of formulating some plan—doing something, only, however, because it was supposed that central station men would come to them with suggestions and explanations and experiences, so that we might before this have gone on to prepare against this day that seems now upon us. As I take it, this resolution that Mr. Weeks has offered means that now we as an association, through our committee, shall prepare some definite plan by which, because of its object, we agree firmly to stand, and by which we propose firmly to establish the business of our constituents. (Applause.) I am heartily in favor of taking the most vigorous method, using the strongest possible means that we can employ, firmly to establish our business, and I am more in favor of that from the reason that any such act cannot, by any possibility, hurt any legitimate enterprise. If that be so, no man can condemn what we suggest doing to-day. (Applause.)

THE PRESIDENT: Is there any other discussion on the subject? This is a very important one, gentlemen.

I would call upon Mr. Wilmerding, of Chicago, to say something on this subject.

MR. WILMERDING: I do not think, Mr. President, that any central station man can differ with Mr. Weeks and Judge Armstrong on this point. We all know what experience some of us have had. Personally, I cannot say that we have suffered very much, and a combination such as has been suggested would take care of the future. That is what we want to look out for. I think that a gentleman present, who has had more experience in this line than I, can say more to the point than I can; Mr. Francisco.

THE PRESIDENT: We would be glad to hear Mr. Francisco.

MR. FRANCISCO: I am rather peculiarly situated on this question. I have been hauled over the coals for the last two years for this very thing. I have been furnishing light at about one-third the cost of producing it, on account of this kind of guerilla warfare, so that I know something about it from actual experience. I am now, as I was at Kansas City, and as I was at Providence, strongly in favor of this movement, and I hope that the central station men of America will take hold of this as a body, united and strong; and there is no question in my mind, if they will do that, but that it will succeed, and that they will support themselves without any difficulty. It is not, as I look at it, a warfare. That is not the idea. It is simply self-protection. That is what we are after, and nothing more. We do not want to inaugurate a warfare against the manufacturing companies or the parent companies. That is not the idea. But we want to simply say to them, when we have purchased a thing that we desire to have the right to use it. What we want is protection. We want them to comply with the agreement they made with us, and we want

report be continued and then we can take it up subsequently.

(The motion was carried.)

REPORT OF THE COMMITTEE ON WORLD'S FAIR.

THE PRESIDENT: The report of the Committee on World's Fair, Marsden J. Perry, Chairman. Are there any members of the World's Fair Commission here? If there is no report from that Committee, Director-General Davis has sent here, as a representative of the World's Fair, the secretary of the electrical part of it, Mr. Hornsby. I take pleasure in introducing Mr. Hornsby to you.

ADDRESS OF MR. HORNSBY.

Gentlemen of the Electric Light Association: The World's Columbian Exposition was very much pleased at the action taken some time ago by your Association in the appointment of a Committee on World's Fair. That courtesy is responsible for my presence here to-day as the commissioned officer of the World's Fair, representing especially the electrical department. I had intended reading a paper on the subject of the World's Fair as a whole. You gentlemen are, however, technical people, and I will try to explain to you practically, instead of reading a paper, just what is contemplated. This (pointing to a map) is the site of the World's Fair. It is 646 acres, 100 of which are to be under roof. This is the north of the park, this the south. This is the lake. Beginning with the lake, for purposes of description: There is a breakwater construction along here with a pier running 1,000 feet this way, with casinos, statues, fountains, etc., along here. This harbor is for pleasure crafts; electric launches will ply there. This is for the entrance

of boats. At the grand entrance there is a large archway, over which will be columns of electric search-lights for the lighting up of the harbor at night. Just here is the colossal statue of Columbia. About here are the statues emblematic of the thirteen original states of the American Union. This is the grand entrance to the World's Fair. Here is the Administration Building, which will be the crown jewel in the diadem of buildings. This building will be 260 feet high, with domes, colonnades, grand entrances—four of them—94 feet in height. On the right of this building, going in, is the Manufacturers' Building, the building to be devoted to the liberal arts. That building will cover 34 acres. It will be dome-shaped, 1,800 feet long by 900 feet wide, the span arching to support the dome, 388 feet across. The building will be 280 feet high and will cost $1,000,000. The contracts are let, and this building is all under way.

This is the Agricultural Building, the Agricultural Annex, the Forestry Building, the Dairy Building, saw mills, etc. These buildings are under one department and will be constructed at a cost of one million dollars, or thereabout, and will include everything that is known in all countries—the products of the farm, the field, and the dairy. The Machinery Building, which will be 500 feet by 900 feet, is to be in every way a modern structure. It is impossible just at this time to tell how far the machinery department will go and where the electrical department will end. In the discussions of the Classification Committee of the World's Fair a year ago the electrical department was given a group under the department of machinery and assigned to a corner of Machinery Hall. Its part was inconsiderable and very little was thought of it. The two learned gentlemen who assisted the Commission to make the classification

insisted that electricity was a branch of machinery, and, as such, was entitled only to the consideration of being grouped with machinery. That has been changed; it is not so now. The Electricity Building is 700 feet long by 350 feet wide, having 240,000 square feet of floor space. It has a 100 foot gallery around the entire extent at an elevation of 38 feet. The roof is 160 feet high, dome-shaped. It is in the Italian Renaissance architecture, under contract to cost $650,000. That is to be purely for the electrical exhibits. The Exposition proper, the magnitude of the Exposition, can be regarded from this standpoint, and it is something that you gentlemen will perhaps be more interested in; that is, the Electrical Annex. The building for the service of the Exposition with electricity occupies a larger scope than it did. Electric launches will be here. An electric intramural railway will traverse the entire length of the ground. This is a mile and three-quarters. The road will be three miles, or thereabouts, long. Electrically propelled elevators will be in all of the buildings. Everything that is done in the shape of power will be by electrical transmission. (Applause.) This will be an expensive plant. The various companies engaged in the supply of light and power will be contracted with to build model lighting and power stations of their own, after their own plans, to be approved only by the Exposition management. This will be a 24,000 horse power plant; a large one, as you gentlemen will know. The distribution from here will be in three directions. These are the terminal tracks for the handling of passengers. Along here will be a tunnel passing down through the Mines Building, which is here; the Transportation Building and its annex—the Horticultural Building, and the Woman's Building, these will be supplied from one source. Another tunnel will be built over here, across

this way, striking the corner of the Mines Building, and passing through, over to the Electricity Building, and passing through, and from there across this bridge, crossing the canal down through the Manufacturers' Building, the Government Building, the Fisheries Building, and this pier, on which will be casinos, statues, fountains, etc. A short tunnel will be built from this power house, going first through Machinery Hall, crossing this bridge here, down through the Agricultural Building, the Agricultural Annex (the saw mills will be run entirely by electrically transmitted power), the Forestry Building and the Dairy. From this plant will be served 8,000 arc lamps, 85,000 incandescent lamps and 4,000 horse power for the operation of the machinery belonging to exhibitors.

This is a wooded island 30 acres in extent, which it is contemplated to use for an aboriginal preserve, if you please. The Indians will probably be here. This island, the lagoons, canals, all of the grounds, will be lighted by electricity. In our own building I have recently finished the plan. We will require in that building, and have arranged for, 800 horse power for the running of exhibits, aside from the operation of exhibits from the exhibitors' own plant, which will be located here as well. In there we will have light proportioned one 2,000 candle power lamp to 1,000 square feet of space. In addition to that, in the centre of the building we will have some spectacular effects, and in all of the corners. 700 arc lamps, I believe, are destined to that building.

A good deal has been said in regard to the finances of our Exposition. You, gentlemen, are financial people, and I may be pardoned for reading you just a few figures. The resources of the Chicago Exposition are as follows :

From stock subscriptions	$5,000,000
From Chicago city bonds authorized by the State	5,000,000
Gate receipts guaranteed	7,000,000
Concessions and privileges	1,000,000
From salvage estimate	3,000,000
Making a total of	$21,000,000

Against these resources are to be drawn amounts as follows:

For ground and buildings	$12,066,000
For administration	3,308,000
For operation May to November	1,550,000

Recapitulating, therefore, the Exposition Company will spend $26,000,000; the United States Government, $1,500,000; the States and Territories have already subscribed $5,000,000—two or three special State exhibits. This is not including $5,000,000 which have been subscribed by foreign governments for the maintenance of their exhibits. The South American states alone have subscribed $2,700,000 for their share.

The following nations have already replied to the invitation sent by the United States Government: Great Britain, the British Empire, France, Germany, Spain, Japan, China, Mexico, Peru, Honduras, Salvador, Costa Rica, Columbia, Cuba, Guatemala, Jamaica, Nicaragua, Chili, San Domingo, Turkey, Ecuador, Denmark, Russia, Egypt, Morocco, Venezuela, Brazil, Hayti and the Argentine Republic. These are almost what we may expect. It is now eighteen months before our Exposition opens. We have almost the entire world to draw from already. It is impossible to say how far we may have to go. Since the inauguration of the movement to make an Exposition at Chicago, it has so developed that the amounts of money already set apart, up to a year ago, have been found inadequate; therefore, an

extra $5,000,000 is being provided by subscription in Chicago, and a loan of $5,000,000 is being arranged for with the United States Government, increasing the resources of the World's Fair to $42,000,000.

So far as we are concerned ourselves, the electrical department has been divided, the service being absolutely separated from the exhibition department. All of the exhibition will be under the superintendence of the chief of the Department of Electricity. Everything electrical in the Exposition will be on exhibition. But this plant here will be purely a service plant, the exhibition feature to be a secondary consideration. It was contemplated originally to install there a service plant proportioned to the good will of the electrical people—free lunch, as some one has been pleased to call it. The management of the Exposition thought it would be impossible, on account of the general interest taken in the Exposition, to have the electrical people donate for the use of the Exposition enough apparatus and enough talent to serve the purposes contemplated. By the hardest work and closest application of the Electrical Department, we have made it appear advantageous, and certainly for the benefit of the electrical people, that that course would not be in accord with their wishes. Their interest would be dampened if such a procedure were to be inaugurated. Therefore, we have been successful in having this plant installed purely as a business proposition; the idea being to demonstrate unequivocally and in practice the economy of an electrical service over that which was contemplated before—steam and gas. In so far we have been successful, and after the Columbian Exposition I think we will be able to demonstrate fully all that has been claimed for electricity on the score of economy, comfort and luxury, if you please. (Applause.) Gentlemen, I thank you.

Mr. Francisco: I move, Mr. President, that a vote of thanks be tendered to the Secretary of the Columbian Exposition for the full, interesting and explicit explanation and description he has given here of the plans for the Columbian Fair.

(The motion was carried.)

Mr. Seely: I move, sir, that you discharge the Committee on the World's Fair, and that the Chair appoint a new one.

Mr. Hornsby: May I be pardoned one moment, Mr. President? There is one other matter I contemplated speaking about, but neglected. I have been in correspondence for six months, or thereabouts, with electrical people in all parts of the world, relative to the holding in Chicago in 1893 of an International Electrical Congress. I have arrived at a point in our correspondence and negotiation at which I can say the project is in the way of being successful beyond our highest hopes. We look for the presence in Chicago at that time of the ablest men in the greatest profession now in existence. The Europeans have promised to have their very highest authorities with us. The best of the electrical people of this country are heart and soul with us; the representatives of the societies in this country and in Europe have signified thier intention of taking active hold of the matter of holding this International Electrical Congress. A good many of these congresses have been held before, largely in Europe. A good deal of satisfactory work has been done in the settlement of standards, the unification of methods, the revision of nomenclature—all of those things. Very little, however, of that work has been done in this country. It seems to be the feeling among scientific men that we are on the eve of a greater revolution than has taken place in the last few years. The chasm which stands between what

we know and what we do not know is deep. It may be unfathomable, and the hidden recesses of nature may not be for our exploring. On the other hand, some man in the vanguard of this work may brush aside the veil that hangs before us and reveal the thing that has been sought so long. The great revolution may be at hand. Why, then, may not this be the time? The bringing together of the Nestors of our science, the concentration of thought, the settlement of methods—all of these things will tend to great good. The standards in the profession can be more fully settled; unquestionably, the nomenclature of the science can be revised, at least in some particulars; and, to the world in general, such a congress as this would do great good. The question has come up whether this should be done through and by the World's Columbian Exposition, or whether it should be done by the various societies. The question should be answered in the affirmative in both instances. It should be done by the societies; they have largely contributed already. It should be done under the auspices of the United States Government, which is the authority for holding the World's Columbian Exposition. As the representative of the Electrical Department, as its accredited commissioner to this Convention, I will say that the Exposition management stands ready now, and at all times, to aid such a movement in any way. A provision has been made in the report of the presiding officer of the Exposition management, which will be read before Congress next winter with a view to having the Government of the United States take official notice of the contemplated electrical congress. The management of the Exposition have already acquiesced in the proposition to build a hall for the holding of this congress on the Exposition grounds. All of the adjuncts of debate will be present. No money will be spared by

the management to make the congress in every way a successful one, and I do hope that at this meeting of this Association, strong, powerful, prominent, representative as it is, that some action shall be inaugurated looking to the starting of the ball which shall roll to be a gigantic one. Something should be developed at this time that shall give us a nucleus around which to work. In the course of time the other societies will take their part. The Electrical Engineers, I understand, have gone far already, and with the help of such societies as these, we have no question about furthering a proposition to hold an International Electrical Congress. (Applause.)

MR. T. C. MARTIN: Mr. President and fellow members: Mr. Hornsby in his remarks has made reference to the work of the American Institute of Electrical Engineers in connection with this congress, and I think I may briefly state what has been done, and then, if you will allow me, suggest that this Association act upon somewhat similar lines.

Two and a half years ago, at least—at any rate before it was known that the World's Fair would go to Chicago, and when some of us still fondly hoped that it would not—the American Institute of Electrical Engineers, taking time by the forelock, appointed a committee to secure the holding of an Electrical Congress or conference in this country. A congress was then about to be held in France, at Paris, at the Exposition, and we sent delegates to that congress. Those delegates—some of our most prominent electrical engineers and inventors, among them being Mr. Edison, Prof. Elihu Thomson, and others of that rank—extended, in the name of the Institute, to the delegates to that electrical congress an invitation to attend such a congress in this country during the Columbian Fair year. The invitation was

received and accepted. During the present year another congress, of like nature, is being held at Frankfort, in Germany. That congress in France was held under the auspices, first, of the French government and of the Exposition authorities, and secondly, under the auspices of the French society. A similar procedure prevails at the present time in Germany with regard to the conference there, and it is being held under the auspices of the government and with the direct support and aid of the German society. Now, I think that Mr. Hornsby has outlined to us just such a line of action for work in this country. It is proposed on the part of the Institute—and when I say that I speak as secretary of the committee which has the work in hand—to work, as far as lies within our power, with the World's Fair authorities, and we think that with the assistance and co-operation of such powerful bodies as this the congress that is held in Chicago in 1893 will not only be the most memorable, but the most useful of all the congresses that have been held up to date, and, as a member of this Association, I think it would be well, in supporting Mr. Seely's resolution, to have a committee appointed that will work, that will commit this Association unreservedly to the support of the World's Fair and make the movement in Chicago and the congress a success. (Applause.)

THE SECRETARY: The following is the motion of Mr. Seely:

"That the Committee on the World's Fair be discharged and that the chair appoint a committee."

The motion was seconded by Mr. Martin.

(The motion was carried.)

THE PRESIDENT: The chair will appoint as such committee, Mr. B. E. Sunny, of Chicago, Mr. Coleman, of Milwaukee, Mr. Hart, of New Orleans, Mr. Royce, of Washington, and Mr. Price, of New York.

The electrical report of the Committee on Data, I believe, is now in order. If Mr. Peck has the report, he will kindly read it.

ELECTRICAL REPORT OF THE COMMITTEE ON DATA.

MR. PECK: As the report of the Electrical Section of the Committee on Data, I wish to present this form by which to record data concerning street lights.

Report of Street Lighting by Electric Arc Lamps for the Municipality of ________, State of ________ for the Census Year ending June 30th, 1890.

NOTE.—First, enter the data for street lighting as the facts were at the close of the census year. Second, enter the data as the facts are at the date on which the information is obtained.

DATE OF REPORTS.	NUMBER OF LAMPS.		CURRENT USED.			CONTRACT.				CIRCUIT.				POWER.		RATE PER UNIT.				
	Single.	Double.	Volts.	Amperes.	Watts.	Term in years.	Rate per annum.	Hours per year.	Nights per year.	Aerial or Underground.	Mileage of wire.	Mileage of streets.	Lamps per mile of street.	Water, or if steam, kind of fuel.	Coal, cost per ton.	A. Per lamp mile.	B. Per lamp hour.	C. Per lamp-mile hour.	D. Per kilowatt mile hour.	E. Per lamp per night.
June 30, 1890...																				
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JUDGE ARMSTRONG: I move that it be received and adopted.

MR. BURLEIGH: And that the Secretary of our Association refer it to the Census Department at Washington, with the request that they so arrange their statistics as to conform to that form.

MR. WEEKS: My attention has been called to a clipping from one of the Kansas City papers, which I find noticed editorially in the *Electrical Engineer* of September 9, regarding the price of street lighting in various cities of the country, and I take it that if data are to have any value whatever they should be accurate, and I am very sorry to see that the data that are given by the Census Department in Census Bulletin No. 100, referred to in this article, are not accurate. For instance, the statement is made that in San Francisco the price is $440.67 for one arc lamp for one year, and in Denver, $58.46. Those statements are made simply without any qualification whatever. I happen to be familiar with the facts in both cases and I know that there is no foundation, absolutely no foundation, for those statements, and I think that it is but just to our good friends, Rollins, of Denver, and Roe, of San Francisco, than whom there are no fairer-minded and juster men in the fraternity, that that statement be corrected. The facts are that in San Francisco, where, it should be remembered, coal is $7.00 a ton, the highest price paid for any one lamp per year is $361.90, and that is a 4,000 candle power lamp maintained at a point remote from the central station, with, of course, a considerable mileage of circuit required, in order to reach that point; and, instead of being so generous, as one would infer brother Rollins has been in Denver, as to give them an arc lamp for $58.46, his good

business sense has led him to do quite otherwise; the rate that he gets there is $150 within a certain radius and $216 outside and for tower lighting; two very different propositions.

In this connection, I want to call attention to the amendment that was suggested by the committee to the scheme proposed by Mr. Foote, that a very important factor in this whole matter—one of the most important factors—is the question of distribution. I have had occasion to look into this matter quite extensively of late, and I find that the distribution of municipal lights ranges all the way from eight and six-tenths lamps per mile of line down to one lamp per mile of line. Any electrical engineer will at once appreciate the importance of this, and that element should always be included if a comparison of prices is made. Of course, there are other elements that occur to almost everyone; the system used, the watts consumed, the period of contract, the price of coal, whether it be water power or natural gas; but the mileage of circuit per lamp seems to have been generally overlooked. It is important in two ways; first, it determines the amount of investment. I find, in the cities that I have looked up, that the investment per lamp in street systems ranges from $35.87 to $190.40. You can readily see that when it comes to operation it will be still more important, as not only has the resistance of the line to be overcome, but it has to be controlled and maintained, and your trimmers have to traverse all of this distance.

I want to say that I think that Mr. Foote, in the schedule proposed, has covered the ground very thoroughly with the amendment suggested by the committee. I hope he will find that it will be readily filled out by the central station men.

MR. FRANCISCO: Mr. Weeks' remarks, calling atten-

tion to this matter of price and to the statements which have been published throughout the country in regard to street lighting, lead me to suggest that there are so many factors that enter into the question of cost that it is utterly impossible, without some such information as we can get from the census statistics, to tell anything about the matter in any way, shape, or manner. You will often see published in the newspapers and magazines statements of the cost of street lighting in different places. They will give the cost in Boston, where steam power is used and coal is $5.50 per ton, and compare that with the cost in some places in the West, where water power is used and no coal is required, and when they are burning in one place 1,000 lights and in the other but 50 lights. As Mr. Weeks says, there is just as much difference in the cost of producing the light, whether you are running a large number or a small number of lights, as there is between burning coal at five or six dollars per ton and using water power costing nothing. In the information which has been disseminated through the country for the use of municipalities, those things have not been brought out at all. They have simply said that gas light in one place cost so much. In one article which I read I saw the statement published that Boston had to pay $180 per year, while Ypsilanti only paid $13. That would carry the idea that the citizens of Boston were being outrageously swindled, whereas the fact is that Ypsilanti uses water power, while Boston uses steam power. You cannot make a good comparison of those things unless you have such facts before you. These statistics that Mr. Foote will furnish may cover that very ground, and will show up all these different points, so that you may make a comparison and make it intelligently. I trust, therefore, that this matter will be thoroughly carried forward.

Mr. Foote: You all know that this subject is one which interested me before I had anything to do with the census. Mr. Weeks has called your attention to some things that the Census Office has done that, on the surface presentation, seemed to be hurtful. I took a little consolation out of these figures, thinking that if they hurt you pretty badly it would show the necessity of giving correct data on my schedule, so that I could make a report that would help you out of the hole. I have prepared a schedule that contains a number of points of inquiry. I submitted that schedule to 37 managers of companies, every one of whom, when they first took up the outline, commenced by the wise remark, "Cut it down." The net cutting down made by the 37 managers was an increase of five points. The outline for street lighting reports that has been submitted to you can be filled out from the information to be obtained from those schedules, provided we get the information on the schedules. Mr. Weeks calls my attention to the fact that we wanted a mile of circuit included; but I cannot make a report on a mile of circuit unless you give me the mile of circuit on your reports. Some of you may think it strange, but the fact is that a great many central station companies do not know anything about the mileage of the circuit. Knowing how difficult these things were to reach, and knowing the necessity —the supreme importance—of having these figures correct when published, I have induced the Superintendent of the Census to appoint Mr. Foster as a special agent to visit central stations in the State of New York, go over the schedules with them, correct and verify their statements, and give his assistance to them in filling out those schedules; so that I may feel, when I have figured for tabulation, that I have something which is *bona fide*, something which is reliable, and

which can be accepted by the people of this country as an authority on that question. That work will be pushed to completion as rapidly as it can be done, and I hope that every man that Mr. Foster may call upon will see the importance of laying aside his business for an hour and giving Mr. Foster the time, so as not to hinder him in his movements, but let him complete the work as soon as possible. I believe that it is possible now, with the opportunity that we have, to so formulate a report for street lighting, contracts and prices, that it will forever wipe out these strong figures, commencing with the highest priced lamp in the country and ending with the lowest priced lamp, with no details given to show why one is high and the other low. You need the most intelligent men detailed to show and explain the figures, so that they may be made understandable, and may serve as a guide for the action of those who undertake to discuss this question. The more I have had to do with this problem of data and statistics, the more conservative I get and the more afraid I am of making any statement whatever with my figures. My friend, Mr. Tiffany, who published that bulletin, started out on the theory that he must ascertain the number of miles of street in a town and the number of lamp posts in a town, and he simply classed every post that had a lamp on it as one "lamp," as he unfortunately called it. He ought to have called it one "post," and then it would have been all right; but he made no discrimination between an eight foot gas burner on a post, or a kerosene lamp on a post, and a tower with 2,000 arc lamps on it. He counted them all as one post, and his schedule is worked out upon that theory. I think you will find, if you have the necessary patience for this work to be done (and it takes time to do it), that you will get a report that will absolutely relieve you

from all the difficulties that you have been under in meeting these figures as to the cost of public lighting. That we will give you as soon as possible—having the two features always in reserve; first, that you give me the figures that are correct, and, secondly, that the Census Office gives me a sufficient amount of clerical help to do the work—both of which are very necessary things. What we want to have are figures that will not lie, and, in order to have those, we must have figurers who will do correct work. (Applause.)

THE PRESIDENT: Is there any further discussion upon the report of that committee? If not, the Secretary will please read the motion.

THE SECRETARY: That the form presented by the Committee on Data be accepted, and that the Secretary of this Association communicate with the census officers and request that they so prepare and arrange their statistics as to conform to this.

THE PRESIDENT: You have heard the motion. Those who favor it will say Aye; those opposed, No. It is carried.

LEGISLATION.

THE PRESIDENT: The next committee to report is the Committee on Legislation, of which Judge Armstrong is Chairman.

MR. ARMSTRONG: The Committee on Legislation has no report to make. The design of that committee was that the members from each State would give the matters of legislation occurring within their jurisdiction to the chairman of the committee, so that it could be formulated and submitted here—a splendid scheme, but, unfortunately, it has not worked at all. In my own State (New Jersey) the Legislature was so busy with political matters, fortunately, as to leave us almost entirely alone—and I think that is about all that we need ask in the way of legislation—to be left alone. I believe that the usual number of underground bills were introduced, and I think that one bill, which I referred to at the last Convention—about getting away up in the air, some 200 or 300 feet—was also introduced; but nothing came of any of those measures. And so, reporting for that committee, I can only report for New Jersey. I do not know whether any of the other members of the committee here present are able to report for their own States as to matters of legislation or not.

MR. WILMERDING: In Illinois, at the last session of the Legislature, there were a great many bills introduced with a view to knocking out our interests. One bill was the one referred to by Mr. Francisco, by which the cities and towns were authorized to carry on a commercial lighting business, not only with electricity, but

with gas. That bill died in the committee. There was another bill introduced to the effect that no wire carrying a voltage of more than 1,000 volts should be operated in the State. That also died in the committee. We were fortunate in having one or two friends in the Legislature who had influence enough to knock out those things. Of course, we have all got to look out for just such action. I suppose it is sandbagging, but they did not make much out of it, and, perhaps, next time they will not attempt it.

MR. FRANCISCO: As a member of the committee from Vermont, I will say that our Legislature only meets once in two years, and therein we are fortunate. We have had no session since the last meeting.

THE PRESIDENT: In the absence of Mr. Maher, who is the member of the committee from New York State, I will say that each year in New York we have had a bill up (we had one winter before last, and there is one down there now), but, as is usually the case in New York City, the tail was trying to wag the dog. In other words, the members of the Electrical Commission in New York City are getting good, fat salaries, and they want to nurse that thing as long as they can. The bill contemplated would wipe them out. So we have got them fighting among themselves, and the result is that nothing has been done in New York State; and we are likely not to have anything done. I presume the same thing will be up during the coming winter, as I know of a gentleman who is a very hot candidate for one of the commissions, but I have no doubt that some of Mr. Seely's friends—Jake Hess, or Theodore Moss, or some other one over there—will be as anxious to retain their positions as they were last winter, and so the tail will still wag the dog, as it did last winter, and we will not have any legislation prejudicial to their interests.

Dr. Bell: Partly as a matter of information, and partly as bearing upon a subject which might develop into something interesting, and as relating to a subject in which I feel considerable interest, as I have had my attention called to it in one way or another in the light of these obnoxious bills, I would like to inquire whether there has ever been any systematic attempt to find out the nigger in the fence in this business. In other words, whether a majority of these bills emanate from cranks, from quasi socialists, from previous competitors, or from what source. Sometimes a little information as to just what interest is at work to further a particular bill might be very useful in assisting various members of the Association in defeating obnoxious measures.

Mr. Armstrong: If the stenographer will not report what I say, I think I may answer Dr. Bell's inquiry.

* * * *

Mr. Scott: I just want to speak in relation to this matter that the gentlemen have spoken about, so far as to suggest that sometimes legislation is produced by the indiscretion of electric light companies themselves. In Pennsylvania we have carefully watched the legislation, and have tried to have everything avoided that was inimical to our interests; but there was a bill passed at the last session which strikes directly at us and affects our interests, and which should not have been passed at all, and could not have been passed (for there was no money in it) but for the determined efforts on the part of its promoters to have it passed. That was a bill in relation to the cutting of trees. It is a most iniquitous piece of legislation, so far as we are concerned. It provides about in this way: "That any citizen, or any person, in any borough, township, or in any city of the first or second-class, who has knowledge of the cutting or trimming of any tree along or upon any public highway, or

the branches of trees upon private property which protrude over the highway, by any telegraph, telephone or electric light company, and who shall lodge proper information, that thereupon the Court of Common Pleas shall appoint a jury of view, and that jury of view shall proceed to assess damages and costs upon such telegraph, telephone or electric light company." There was an influence brought to bear in favor of that bill which could not be overcome. Some of us took the trouble to contest it, and found that the Suburban Electric Light Company, of Philadelphia—a county company—had asked the land associations along their route for the privilege of cutting trees. They went to the Secretary's office and asked for this privilege, and he said, "Yes, you can cut all you want to," meaning just to cover the right of way outside of their fences. But that company went to work and cut down trees that were inside of the fences. Any one traveling from Philadelphia to New York can see for over half a mile the fine trees lying right there on the road alongside the railroad track, along the State road from Philadelphia to Trenton. Well, it was a bad thing to do (laughter); and the Land Association (which is composed of politicians of Philadelphia who can carry any measure through the Legislature) decided at once that they would stop that business; so they put this bill through. It is not merely the aggrieved property holders, or any body who may have any particular interest in the matter, but any d—d tramp who comes along the road may lodge an information before the Court of Common Pleas, and then the damages have got to be assessed, even if it is only ten cents, upon the complaint of that tramp.

Those things ought to be looked into. We ought to be careful on our own part in seeking legislation—just as careful as if it were legislation by our competitors or by

our enemies. There is another matter of legislation that we have tried to accomplish in Pennsylvania. It is understood by everyone who has had interest enough to look the matter up, that gas and water companies have an exclusive right, such an exclusive right that electric light companies cannot get in. In a small town—like our own town of Bristol, of eight thousand inhabitants, where a gas company has been running since 1856, and has been paying eight or ten per cent. dividend right along—there is no reason why a gas company should have exclusive rights, while an electric light company which has invested $20,000 or $30,000 in its plant, and has finally got the thing running, is compelled to buck against any one who may choose to come in and make a competition. Those matters can be arranged in time, but, of course, it may take a long time, and it will require a great deal of trouble and effort on the part of somebody. We can do a thing of that kind in a better way than by use of money; we can accomplish what we wish by argument. If you will just show the people who are interested in the corporation—your own stockholders, the men who have put down their stamps for the purpose of carrying on the business—that there is something they have got to look out for; that just as soon as we begin to make eight or ten per cent. and to accumulate a surplus, the gas company or the water company in their own town, using the power which they can apply to that purpose, can run a pole line right along the side of us and can take our customers right away by cutting rates—that they can do this because they have an exclusive charter, whereas we cannot go in and manufacture gas or put water through the streets as they can do; I say that if you make your stockholders understand this, you may accomplish much.

There are a great many of these questions that come up in this country, and that ought to be looked after, not only by the Committee on Legislation, but it ought to be the business of every man connected with a central station company, from officers to stockholders, to look out in this way for his own pocket book. (Applause.)

DR. BELL: There is one further suggestion with regard to the matter of legislation that I would like to bring before the Association, more, perhaps, for the purpose of getting the facts about it than for the sake of suggesting any possible remedy—because it would require a careful study to do that—and that is the existence of the *fake* electric light companies—companies existing only on paper, with a Board of Directors, usually composed of the stockholders of the local gas company, holding meetings once a year, if it is absolutely required by law, and existing simply for the purpose of stopping legitimate electrical enterprises. I speak with some feeling on the subject because I have happend to live at one time and another in two or three towns of comparatively small size where this particular kind of work was being deliberately carried on by the gas company. They had obtained charters, and they simply hung on to them, staying there like dogs in the manger, refusing to let any electric light company get a foothold and stopping the organization of new companies. Even if they were not possessed of exclusive charters, their mere existence in a state which might become on a very short notice active, checks opposition and enables extortionate rates to be secured for gas, and, at the same time, prevents the organization of an electric light company. In the first place, it is an outrage upon electrical people in general who want to see the electric light extended; and, in the next place, it is particularly tough on companies which might, if permitted in towns, do a great deal of electric lighting.

It is hard on all parties concerned. I do not know whether there can be a reasonable possibility of legislative prevention of this, but it would be a mighty good work for this Association to take up.

THE PRESIDENT: Is there any further discussion? What is your pleasure in regard to the report of the committee?

MR. SEELY: I move that the report of the committee be received, and that the committee be continued. (Carried.)

THE PRESIDENT: Next in order is the report of the Committee on Underground Conduits and Conductors, of which Mr. Francisco is Chairman.

MR. FRANCISCO: In behalf of the Committee on Underground Conduits, I have to say, that we have undertaken quite a task. We have found that the subject of underground conduits is one that is liable to involve quite a study in relation to a great many statistics and a great many points. We went to work to get to the bottom—to get at the facts. We have collected a good deal of information in regard to that matter, but the time has been so short that we confess it has been impossible to get all the matter that we had a report on ready at this meeting. I have been in correspondence with parties in London with regard to the entire underground conduit business of London, but the report that I expected to have here to-day has not yet arrived, on account of the time being so short in which to get the correspondence back and forth. The same statement is true with regard to several places in the United States. Therefore, we did not feel like making a report which would contain merely a partial statement of facts, because several central station companies have stated to me that they do not want anything but facts, and that they want to base their calculations upon what we find to be facts,

with regard to what they are going to do. The position that I have taken, and that the committee took, is that if there are several systems of underground wiring which are practical and proper, we want to find out which is the best system, and then leave those who want to adopt one, upon the information which we may obtain, to decide as to that which is the best, the most practicable, and the most serviceable. We cannot get the information and come to that decision in the time allotted for making our report at this meeting. Therefore, we shall have to ask the Convention to extend the time if they want the information.

On motion of Mr. Armstrong, seconded Mr. Weeks, the committee was continued, and requested to report at the next meeting.

THE PRESIDENT: We will now hear the report of the Committee on Safe Wiring, of which Mr. De Camp is Chairman.

MR. ARMSTRONG. Mr. T. Carpenter Smith had this report, but, as he was feeling quite unwell, he asked me to read it for him, as he had to leave the hall.

Mr. Armstrong read the following report:

REPORT OF COMMITTEE ON SAFE WIRING.

To the President and Members of the National Electric Light Association:

GENTLEMEN:— Your Committee on Tabulating Wiring and Insurance Rules beg leave to report that they have had several meetings and conferences with representatives of the various interests involved, and as a result have formulated certain preliminary requirements which they think essential to safe wiring.

These must not be considered as rules to be absolutely followed, but rather in the nature of suggestions as to the line upon which each local association may form its own rules in detail. These requirements are as follows:

CLASS A.

CENTRAL STATIONS FOR LIGHT OR POWER.

These Rules also apply to Dynamo Rooms in Isolated Plants, connected with or detached from buildings used for other purposes. Also to all varieties of apparatus, of both high and low potential.

GENERATORS OR MOTORS—Must be:

1. Located in a dry place.

2. Insulated on floors or base-frames, which must be kept filled to prevent absorption of moisture, and also kept clean and dry.

3. Not exposed to flying or combustible materials.

4. Each covered with a waterproof cover when not operating.

In no case must a generator be placed in a room where any hazardous process is carried on, such as the working room of a cotton, jute, flax, woolen or flour mill.

CARE AND ATTENDANCE.—A competent man must be kept on duty in the room where generators are operating.

Oily waste must be kept in metal cans and removed daily.

CONDUCTORS.—From generators, switchboards, rheostats or other instruments, and thence to outside lines, conductors must be:

1. In plain sight.

2. Wholly on non-combustible insulators, such as glass or porcelain.

3. Separated from contact with floors, partitions or walls through which they may pass by non-combustible insulating tubes.

4. Kept rigidly so far apart that they cannot come in contact.

5. Covered with non-inflammable insulating material sufficient to prevent accidental contact.

6. Ample in carrying capacity to prevent heating. (See Capacity of Wires Table.)

7. Connected by splices or joints equal in carrying capacity to the conductors themselves, soldered if necessary to make them efficient and permanent.

8. When under floors or in distributing towers, placed in spaces ample for inspection and ventilation, and provided with special insulating covering.

SWITCHBOARDS—Must be:

1. So placed as to make it impossible to communicate fire to surrounding combustible material; accessible from all sides when the connections are on the back; or

may be placed against a brick or stone wall when the connections are entirely on the face.

2. Kept free from moisture.

3. Made of non-combustible material, or of hard wood, filled to prevent absorption of moisture.

4. Equipped with bars and wires in accordance with rules 1, 2, 3, 4, 5, 6 and 7 for placing conductors.

RESISTANCE BOXES AND EQUALIZERS—Must be:

1. Equipped with metal or non-combustible frames.

2. Treated as sources of heat.

3. Placed on the switch, or a distance of a foot from combustible material, or separated therefrom by asbestos or cement.

LIGHTNING ARRESTERS—Must be:

1. Attached to each side of every overhead circuit connected with the station.

2. In plain sight.

3. On the switchboard or in an equally accessible place, away from combustible material.

4. Connected with at least two earths by separate wires of large size.

5. So constructed as not to maintain an arc after the discharge has passed.

TESTING.—All series and alternating circuits must be tested every two hours while in operation, to discover any leakage to earth, abnormal in view of the potential and method of operation.

All multiple arc low potential systems (300 volts or less) must be provided with an indicating or detecting device, readily attachable, to afford easy means of testing where the station operates perpetually.

Data obtained from all tests must be preserved for examination by insurance inspectors.

CLASS B.

Arc (Series) Systems.

Overhead Conductors.—All outside overhead conductors (including services) must be:

1. Covered with some insulating material not easily abraded.

2. Firmly secured to properly insulated and substantially built supports, all the wires having an insulation equal to that of the conductors they confine.

3. So placed that moisture cannot form a cross-connection between them; not less than a foot apart and not in contact with any substance other than proper insulating supports.

4. At least seven feet above the highest point of flat roofs and at least one foot above the ridge of pitched roofs, over which they pass or to which they are attached.

5. Protected whenever necessary, in view of possible accidents to conductors or supports, from possibility of contact with other conducting wires or substances to which current may leak, by *dead insulated guard irons or wires.* Special precautions of this kind must be taken where sharp angles occur, or where any wires might possibly come in contact with electric light or power wires.

6. Provided with petticoat insulators of glass or porcelain. Porcelain knobs and rubber hooks are prohibited.

7. So spliced or joined as to be both mechanically and electrically secure without solder. They must then be soldered to insure preservation, and covered with an insulation equal to that on the conductors.

The following formula for soldering fluid is approved:

Saturated Solution of Zinc.......5 parts.
Alcohol........................4 parts.
Glycerine......................1 part.

Conductors should not be run over or attached to buildings other than those in which light or power is being, or is to be, used, but on separate poles or structures always easily inspected.

SERVICE BLOCKS must be covered over their entire surface with at least two coats of waterproof paint and so maintained.

WIRES FOR HIGH AND LOW POTENTIAL circuits *should not* occupy the same support.

TELEGRAPH, TELEPHONE AND SIMILAR WIRES must not be placed on the same arm with electric or power wires and *should not* be placed on the same structure or pole.

INTERIOR CONDUCTORS.

ALL INTERIOR CONDUCTORS—Must be:

1. Where they enter buildings from outside terminal insulators to and through the walls, covered with extra moisture-proof insulation, and must have drip loops outside, preferably slanting upward toward the inside and bushed with moisture-proof and non-combustible insulating tube.

2. Arranged to enter and leave the building through a double contact service switch, which will effectually close the main circuit and disconnect the interior wires when it is turned "off." The switch must be so constructed that it shall be automatic in its action, not stopping between points when started, and prevent an arc between the points under all circumstances; it must indicate on inspection whether the current be "on" or "off," and be mounted on a non-combustible base in a position where it can be kept free from moisture, and easy of access to police or firemen.

3. Always in plain sight, never covered, except in special cases, where an armored tube may be necessary.

4. Covered in all cases with a moisture-proof non-

combustible material that will adhere to the wire, not fray by friction, and bear a temperature of 150 degrees F. without softening.

5. In dry places, kept rigidly apart at least one foot, except when covered (in addition to insulation) by a moisture-proof non-conducting and non-inflammable tubing, which must be strong enough to protect the insulating covering from injury. Conductors thus placed may be run not less than three inches apart, and be fastened with staples, under which are placed mechanically rigid insulating strips or saddles of greater width than the metal of the staple, by which possibility of injury to the tube may be prevented.

6. In damp places, attached to glass or porcelain insulators, and separated ten inches or more.

7. When passing through walls, floors, timbers or partitions, treated as in central stations under like conditions.

Lamps and Other Devices.

Arc Lamps Must Be In Every Case:

1. Carefully isolated from inflammable material.

2. Provided at all times with a glass globe surrounding the arc, securely fastened upon a closed base. No broken or cracked globes may be used.

3. Provided with a hand switch, also an automatic switch, that will shunt the current around the carbons should they fail to feed properly.

4. Provided with reliable stops to prevent carbons from falling out in case the clamps become loose.

5. Carefully insulated from the circuit, in all their exposed parts.

6. Where inflammable material is near or under the lamps, provided with a wire netting around the globe and a spark-arrester above, to prevent escape of sparks, melted copper or carbon.

Incandescent lamps in series circuits, having a maximum potential of 350 volts or over, must be governed by the same rules as for arc lights, and each series lamp provided with a hand switch and automatic cut-out switch; when lights are in multiple series, such switches and cut-outs must not control less than a single group of lights. Electro-magnetic devices for switches are not approved.

Under no circumstances will incandescent lamps on series circuits be allowed to be attached to gas fixtures.

CLASS C.

Incandescent (Low Pressure) Systems—300 Volts or Less—Overhead Conductors.

Outside Overhead Conductors—Must be:

1. Erected in accordance with general rules for Arc (Series) Circuit Conductors.

2. Provided with suitable safety fuses at junctions of distributing mains with feeding conductors.

3. Separated not less than six inches, where they enter buildings as service conductors, and be provided with a double pole fusible cut-out, as near as possible to the point of entrance to the building, and outside the walls, when practicable.

Underground Conductors.

Underground Conductors—Must be:

1. Provided with suitable protecting devices at the ends of tube or conduit services inside the walls of buildings, as a guard against moisture and injury.

2. Terminated at a properly placed double pole house cut-out.

3. Of specially insulated conductors after leaving the tube or conduit, and separated by at least ten inches, until the double pole cut-out is reached.

Inside Wiring.

Wire should be so placed that in the event of the failure or deterioration of their insulating covering the conductors will still remain insulated.

At the entrance of every building there shall be a double pole switch placed in the service conductors, whereby the current may be entirely cut off.

Conductors Must Not Be:

1. Of sizes smaller than No. 16 B. & S., No. 18 B. W. C. or No. 3 E. S. G.

2. Lead or paraffine covered.

3. Covered with soft rubber tube.

4. Laid in mouldings of any kind in damp places.

5. Laid in mouldings with open grooves against the wall or ceiling.

6. Laid in mouldings where less than half an inch of solid insulation is between parallel wire, and between wires and walls or ceilings.

7. Laid in plaster, cement or similar finish.

8. Concealed unless easily accessible, and preferably in approved conduits or wire-ways.

Mouldings, where admissable, must have at least two coatings of waterproof paint, to be impregnated with a moisture repellent.

Cleatwork is not desirable, and cleats must *not* be used unless:

1. In a very dry place.

2. In a place perfectly open for inspection at any time.

3. They are of porcelain, or well-seasoned wood, filled, to prevent absorption of moisture.

4. They are so arranged that wires of opposite polarity with a difference of potential of 150 volts or less, will be kept at least two and one-half inches apart, and that

where a higher voltage is used this distance be increased proportionately.

5. There is a backing provided, of wood at least half an inch thick, well seasoned and filled, to prevent absorption of moisture.

STAPLES must never be used to fasten conductors, unless:

1. Provided with an insulating sleeve or saddle rigidly attached to the metal of the staple, and having such strength and surface as to prevent mechanical injury to the insulation of the conductor.

2. Under conditions in which cleatwork would be acceptable, or where driven into a moulding specially adapted for open work.

SPECIAL WIRING.

Wherever conductors cross gas, water or other metallic pipes, or any other conductors or conducting material (except arc light wires), they should be separated therefrom by some continuous non-conductor at least one inch. In crossing arc light wires the low tension conductors must be placed at a distance of at least six inches. In wet places an air space must be left between conductors and pipes in crossing, and the former must be run in such a way that they cannot come in contact with the pipe accidentally. Wires should be run *over* all pipes upon which condensed moisture is likely to gather, or which by leakage might cause trouble on a circuit.

In rooms where inflammable gases may exist, or where the atmosphere is damp, the incandescent lamp and socket should be enclosed in a vapor tight globe.

In breweries, stables, dye-houses, paper and pulp mills, or other buildings specially liable to moisture, all conductors, except where used for pendants, must be:

1. Separated at least six inches.

2. Provided with a durable, waterproof covering.

3. Carefully put up.

4. Supported by porcelain or glass insulators.

Moisture-proof and non-inflammable tubing may be accepted in lieu of such construction.

No switches or fusible cut-outs will be allowed in such places.

INTERIOR CONDUITS MUST NOT BE:

1. Combustible.

2. Of such material or construction that the insulation of the conductor will ultimately be injured or destroyed by the elements of the composition.

3. So constructed or placed that difficulty will be experienced in removing or replacing the conductors.

4. Subject to mechanical injury by saws, chisels or nails.

5. Supplied with a twin conductor in a single tube where a current of more than 10 amperes is expected.

6. Depended upon for insulation. The conductors should be covered with moisture-proof material.

The object of a tube or conduit is to facilitate the insertion or extraction of the conductors, to protect them from mechanical injury, and as far as possible from moisture.

Twin tube conductors must not be separated from each other by rubber or similar material, but by cotton or other readily carbonizable substance.

Conductors passing through walls or ceilings must be encased in a suitable tubing, which must extend at least one inch beyond the finished surface until the mortar or other similar material be entirely dry, when the projection may be reduced to half an inch.

DOUBLE POLE SAFETY CUT-OUTS—Must be:

1. Placed where the overhead or underground conductors enter a building and join the inside wires.

2. Placed at every point where a change is made in the size of the wire (unless the cut-out in the larger wire will protect the smaller). This includes all flexible conductors. All such junctions must be in plain sight.

3. Constructed with bases of non-combustible and moisture-proof material.

4. So constructed and placed that an arc cannot be maintained between the terminals by the fusing of the metal.

5. So placed that on any combination fixture, no group of lamps requiring a current of six amperes or more, shall be ultimately dependent upon one cut-out.

6. Wherever used for more than six amperes, or (where the plug or equivalent device is not used) equipped with fusible strips or wires provided with contact surfaces or tips of harder metal soldered, or otherwise having perfect electrical connection with the fusible part of the strip.

SAFETY FUSES must be so proportioned to the conductors they are intended to protect, that they will melt before the maximum safe carrying capacity of the wire is exceeded.

All fuses, where possible, must be stamped, or otherwise marked, with the number of amperes equal to the safe carrying capacity of the wire they protect.

All cut-out blocks when installed must be similarly marked.

The safe carrying capacity of a wire changes under different circumstances, being about forty per cent. less when the wire is closed in a tube or piece of moulding than when bare and exposed to the air, when the heat is rapidly radiated. It must be clearly understood that the size of the fuse depends upon the size of the smallest conductor it protects, and not upon the amount of current to be used on the circuit. Below is a table

showing the safe carrying capacity of conductors of different sizes in Birmingham, Brown & Sharp, and Edison gauges, which must be followed in the placing of interior conductors.

Brown & Sharp.		Birmingham.		Edison Standard.	
Gauge No.	Amperes.	Gauge No.	Amperes.	Gauge No.	Amperes.
0000	175	0000	175	200	175
000	145	000	150	180	160
00	120	00	130	140	135
0	100	0	110	110	110
1	95	1	95	90	95
2	70	2	85	80	85
3	60	3	75	65	75
4	50	4	65	55	65
5	45	5	60	50	60
6	35	6	50	40	50
7	30	7	45	30	40
8	25	8	35	25	35
10	20	10	30	20	30
12	15	12	20	12	20
14	10	14	15	8	15
16	5	16	10	5	10
		18	5	3	5

Switches—Must:

1. Be mounted on moisture-proof and incombustible bases, such as slate or porcelain.

2. Be double pole when the circuits which they control are connected to fixtures attached to gas pipes, and when six amperes or more are to pass through them.

3. Have a firm and secure contact, must make and break readily, and not stick when motion has once been imparted by the handle.

4. Have carrying capacity sufficient to prevent heating above the surrounding atmosphere.

5. Be placed in dry, accessible places, and be grouped as far as possible, being mounted, when practicable, upon slate or equally indestructible back boards.

Motors.—In wiring for motive power, the same precautions must be taken as with the current of the same volume and potential for lighting. The motor and

resistance box must be protected by a double pole cut-out and controlled by a double pole switch.

ARC LIGHTS ON LOW POTENTIAL CIRCUITS—Must be:

1. Supplied by branch conductors not smaller than No. 12 B. & S. Gauge.

2. Connected with main conductors only through double pole cut-outs.

3. Only furnished with such resistances or regulators as are enclosed in non-combustible material, such resistances being treated as sources of heat.

4. Supplied with globes protected as in the case of arc lights on high potential circuits.

FIXTURE WORK.

1. In all cases where conductors are concealed within, or attached to fixtures, the latter must be insulated from the gas pipe system of the building.

2. When wired outside, the conductors must be so secured as not to be cut or abraded by the pressure of the fastenings, or motion of the fixtures.

3. All conductors for fixture work must have a waterproof insulation that is durable and not easily abraded, and must not in any case be smaller than No. 16 B. & S., No. 18 B. W. G., or No. 3 E. S. G.

4. All burrs or fins must be removed before the conductors are drawn into a fixture.

5. The tendency to condensation within the pipes must be guarded against by sealing the upper end of the fixture.

6. No combination fixture in which the conductors are concealed in a space less than one-fourth inch between the inside pipe and the outside casing will be approved.

7. Each fixture must be tested for possible "contacts" between conductors and fixture, and for "short

circuits," before the fixture is connected to its supply conductors.

8. The ceiling blocks of fixtures should be made of insulating material.

Electric Gas Lighting.

Where electric gas lighting is to be used on the same fixture with the electric light:

1. No part of the gas piping or fixture shall be in electrical connection with the gas lighting circuit.

2. The wires used with the fixtures must have a non-inflammable insulation, or where concealed between the pipe and shell of the fixture, the insulation must be such as is required for fixture wiring for the electric light.

3. The whole installation must test free from "grounds."

4. The two installations must test perfectly free of connection with each other.

Pendants and Sockets.

No portion of the lamp socket exposed to contact with outside objects must be allowed to come into electrical contact with either of the conductors.

Cord Pendants—Must be:

1. Made of conductors, each of which is composed of several strands insulated from the other conductor by a mechanical separator of carbonizable material, and both surrounded in damp places with a moisture-proof and a non-inflammable layer.

2. Protected by insulating bushings where the cord enters the socket.

3. So suspended that the entire weight of the socket and lamp will be borne by knots, above the point where the cord comes through the ceiling block or rosette, in order that the strain may be taken from the joints and

binding screws. All sockets used for wire or cord pendants should have openings at least equal to one-quarter inch gas-pipe size.

4. Allowed to sustain nothing heavier than a four-light cluster, and in such a case special provision should be made by an extra heavy cord or wire, as a mechanical reinforcement.

5. Equipped with keyless sockets as far as practicable, controlled by wall switches. In no case may a lamp giving more than fifty (50) candle power be placed in a key-socket on a flexible pendant.

CLASS D.

Alternating Systems.—Converters or Transformers.

Converters—Must not:

1. Be placed inside of any building, except the central station, unless as hereinafter provided.

2. Be placed in any but metallic or non-combustible cases.

3. Be attached to the outside walls of buildings, unless separated therefrom by substantial insulating supports.

4. Be placed in any other than a dry and convenient location (which can be secured from opening into the interior of the building, such as a vault) when an underground service is used.

5. Be placed without safety fuses at the junction between main and service conductors and safety fuses in the secondary circuits where they will not be affected by the heat of the converter.

Primary Conductors.

In those cases where it may not be possible to exclude the transformers and primary wires entirely from

the building, the following precautions must be strictly observed :

1. The transformer must be located at a point as near as possible to that at which the primary wires enter the building.

2. Between these points the conductors must be heavily insulated with a coating of moisture-proof material, and, in addition, must be so covered and protected that mechanical injury to them or contact with them shall be practically impossible.

3. The primary conductors, if within a building, must be furnished with a double pole switch, and also with an automatic double pole cut-out where the wires enter the building, or where they leave the main line, on the pole or in the conduit. These switches should, if possible, be enclosed in secure and fireproof boxes outside the building.

4. The primary conductors, when inside a building, must be kept apart at least ten inches, and at the same distance from all other conducting bodies.

Secondary Conductors.

The conductors from the secondary coil of the transformer to the lamps or other translating devices must be installed according to the rules for "inside wiring" for "Low Potential Systems."

CLASS E.

Electric Railways.—Power Stations.

All rules pertaining to arc light wires and stations, shall apply (so far as practicable) to street railway power stations and their conductors.

Railway Systems with Ground Return.

Electric railway systems in which the motor cars are driven by a current from a single wire, with ground or floor return circuit, are prohibited, *except* as hereinafter provided:

1. When there is no liability of other conductors coming in contact with the trolley wire.

2. When the location of the generator is such that the ground circuit will not create a fire hazard to the property.

3. When an approved automatic circuit breaker or other device, that will immediately cut off the current in case the trolley wires become grounded, is introduced in each circuit as it leaves the power station. This device must be mounted on a fireproof base and be in full view of the attendant.

Trolley Wires.

Trolley Wires—Must be:

1. No smaller than No. 0 B. & S. copper, or No. 4 B. & S. silicon bronze, and must readily stand the strain put upon them when in use.

2. Well insulated from their supports, and in case of the side or double pole construction, the supports shall also be insulated from the poles immediately outside the trolley wire.

3. Capable of being disconnected at the power house, or of being divided into sections, so that, in case of fire on the railway route, the current may be shut off from the particular section and not interfere with the work of the firemen in extinguishing the flames. This rule also applies to feeders.

4. Safely protected against contact with all other conductors.

Car Wiring.

All wires in cars must be run out of reach of the passengers, and shall be insulated with a waterproof insulation.

Lighting and Railway Power Wires.

Lighting and power wires must not be permitted in the same circuit with trolley wires with a ground return, except in street railway cars, car houses and power stations. The same dynamo may be used for both purposes, provided the connection from the dynamo for each circuit shall be a double pole switch so arranged that only one of the circuits can be in use at the same time.

CLASS F.

Batteries.

When current for light and power is taken from primary or secondary batteries, the same general regulations must be observed as apply to such wires fed from dynamo generators, developing the same difference of potential.

CLASS G.

Miscellaneous.

1. The wiring in any building must test free from "grounds" before the current is turned on. This test may be made with a magneto-bell that will ring through a resistance of 20,000 ohms, where currents of less than 250 volts are used.

2. No ground wires for lightning arresters may be attached to gas pipes within the building.

3. All conductors connected with telephone, district messenger, burglar alarm, watch clock, electric time and

other similar instruments must, if in any portion of their length they are liable to become crossed with circuits carrying currents for light or power, be provided near the point of entrance to the building with some protective device which will operate to shunt the instruments in case of a dangerous rise of potential, and will open the circuit and arrest an abnormal current flow. Any conductor normally forming an innocuous circuit may become a source of fire hazard if crossed with another conductor through which it may become charged with a relatively high pressure.

A. J. De Camp, *Chairman*,
M. D. Law,
Stephen E. Barton,
Wm. Brophy,
T. Carpenter Smith.

Certain questions have come before the committee, which they considered of too great importance to be decided at this stage. Among these are the subjects of the grounding of the neutral wire in compensating or three wire systems; the grounding, either permanently or by automatic cut-outs, of the secondary wires in transformer systems; the adoption of a uniform alloy for fusible cut-outs, and the adoption of better methods for testing circuits.

From the nature of the electrical business and the rapid advance it is making, there must, of necessity, questions continually arise which can only be decided by a later and larger experience; therefore, the object of the Association would be best served by the appointment of a permanent committee to whom should be referred all such questions, which they shall consider and report upon at the next succeeding meeting of the Association.

Your committee, therefore, offer the following:

Resolved: That a Committee of five be appointed by the President, to be a permanent committee on safe methods of construction and operation—any vacancies that may occur on the committee from time to time to be filled by the President.

Committee,

WM. MCDEVITT,
T. CARPENTER SMITH,
WM. BROPHY,
M. D. LAW.

MR. PECK: I move that the report of the committee be received, and that the Secretary be authorized to print the same at once and present copies of it to the members of the Association, and that the discussion of it be made the first order of business on Thursday morning. It seems to me to be a very important report.

MR. ARMSTRONG: It seems to me that it would be absolutely impossible for the Convention to obtain any adequate idea of these rules and recommendations unless they become more familiar with them than is possible from having the report read.

THE PRESIDENT: It has been moved by Mr. Peck, seconded by Mr. Armstrong, that the Report of the Committee on Safe Wiring be received, and that the Secretary be authorized to print the same at once and to present every member with a copy, and that the matter come up for discussion on Thursday morning. Are you ready for the question on that motion?

MR. SEELY: These papers have all been ordered to be printed, and why printed copies are not here I do not know. But this paper is a very important one. There are a great many regulations and recommendations in the paper that seriously affect those who have money

invested in electric lighting. There is no question in my mind but that this Association has got to adopt rules for proper construction. Therefore, I think that this matter should be postponed for at least one or two days, to give these gentlemen an opportunity to carefully consider this paper, and then take up each of its sections separately, so that each member may determine for himself whether or not he is affected by the recommendations. One gentleman states that it will cost him $5,000 to carry out one of the suggestions made in that paper. I do not believe that the Association is organized for the purpose of running us in debt, or incurring expense, or to do wiring to suit some particular insurance company; but I do think that this paper should be taken up in detail, section by section, and thoroughly discussed.

MR. LAW: As I was, perhaps, as instrumental as any member of the committee in preparing those rules for safe wiring, I wish to call the attention of the Convention to the fact that it is divided into three sections. I have found some misunderstanding with regard to that. One section says what you shall do, another section says what you shall not do, and another section says what you should do. Perhaps some of the sections that look a little bit obnoxious may be those that *recommend* you to do thus and so, instead of saying that you *shall* or *shall not* do it. I call your attention to that, so that you may notice these points when you come to read the rules.

MR. AYER: As Mr. Seely says, this is a matter of such importance that we ought not to pass upon it without having the paper before us so that we may have exact knowledge of what there is in it. As it is read before us, none of us can fully understand it, or take it all in. We may possibly misjudge it if we are not afforded an opportunity to read it carefully. It is

very important that all such papers should be printed and put in proper shape for circulation. It is possible that we cannot do it at this meeting; but, not with a view of obstructing action, but of expediting matters and of getting a set of rules for safe wiring adopted by the Convention, I would suggest, as an amendment to the resolution offered, to have this report printed at once and the copies circulated, so that it may be fully discussed. I think it wise that this should be done. It will require a good deal of attention on the part of the members to properly act upon it. Those present are the only ones who are here to act upon it, and I doubt if we could possibly get action upon it at this Convention in any other manner.

MR. HAMMER: I want to make a remark in seconding the motion. I have seen many of these reports, both across the water and on this side, and I can endorse this report as being the most complete thing of the kind that I have ever seen. It is concise; it goes right to the point. Undoubtedly there are in it some things that can be criticised by supply manufacturers, by wire men, and by contractors; but, as an electrical engineer, who has had considerable experience in applying just such things from the incipient stages of electric lighting, I emphatically endorse this as being the best report of the kind that I have ever seen. I hope that it will come up for very extensive discussion. There are some criticisms that I should like to make, and there are, probably, some changes which could be advantageously made.

MR. BROPHY: I have labored for two years as a member of the committee on this subject. As a member of that committee I did not assume that we could not make mistakes. The subject is here for discussion and the report is here for criticism by this Association.

If the report is to be adopted by this Association, it should be done as soon as possible. I, therefore, hope that every effort will be made to print it and to put it in such shape that it will be in circulation before the adjournment of this Convention. I think that we can get it done, and finish this work up. The committee take a good deal of pride in being able to make a report at the next session after they were appointed, and we hope to see our work finished here. (Applause.)

DR. MASON: May I make a suggestion that will facilitate the matter? I move, as an amendment, that the report be printed with the utmost despatch, and be brought before the Association at the earliest possible moment thereafter. Then we do not put off the consideration of it for two or three days, but simply until the earliest possible moment when it can be brought properly before the Convention.

MR. AYER: It seems to me that is a little unwise, as we may then have to go into the consideration of this subject whenever the matter shall come up for action; whereas, if you will assign a definite time for the discussion of it, it is possible that all who are interested in the subject will be here and take part in the discussion.

A MEMBER: I move that we make it the special order for Friday morning.

DR. MASON: I have no desire to press the amendment, but my thought was to bring the matter before us at the earliest practicable moment. But if the gentlemen feel that they want a definite time set for the discussion of the paper, let the time be fixed.

THE PRESIDENT: Will you state your amendment again?

DR. MASON: That the paper be printed with the utmost despatch and be made the order of business at the earliest practicable moment thereafter.

The President: You have heard the amendment to the motion of Mr. Peck. Are there any further remarks? Are you ready for the question on the amendment? Those who are in favor of printing the paper and bringing it up for discussion as soon as practicable, will say Aye. The contrary, No. The ayes seem to have it. The amendment is carried. The original motion by Mr. Peck was that the report of the Committee on Safe Wiring be received, and that the Secretary be authorized to print the same at once and to present copies to the members of the Association, and that it come up for discussion on Thursday morning. This was amended so as now to read, "as soon as practicable."

The motion of Mr. Peck, as amended, was then carried.

The order of business for to-day has now been completed. I will state that all the papers, with the exception of that of Mr. Warner and that of Captain Eugene Griffin, are in the hands of the Secretary, and members can procure copies of them at any time upon application to him. The order of business will have to be changed somewhat, under the direction of the Executive Committee, owing to the fact that we cannot get those two papers out of the hands of the printer for use to-morrow morning. But all the other papers are in pamphlet form, and can be procured of the Secretary.

I am requested by Professor Bovey to say that, inasmuch as there has been some friction, and perhaps some shortcomings, in regard to sending out the invitations to the garden party and the reception at McGill University this evening, that any and all members of the Association are very cordially invited to attend. He wishes me to say that he would be very glad if everyone would avail himself of the invitation to meet at McGill University,

whether he has received cards or not. I will ask members to take it upon themselves to inform those who are not here this morning that they can obtain cards at the Secretary's office at the close of this session.

MR. WEEKS: I think it is proper, before we adjourn, to call your attention to Article V. of our Constitution, which reads: "The annual meeting of this Association shall be held in February, and a semi-annual meeting may be held in August, in each year, at such place as the Association shall determine, and on such dates as may be determined by the Executive Committee," and to remind you that, by changing the date of this semi-annual meeting, our Constitution has been violated. I think that it is proper to make this mention, and, in making it, I want to be understood as fully appreciating the kind hospitalities of the people of Montreal and Canada. I want, also, to say that I think I have some adequate comprehension of the indefatigable labors and self-sacrifices that have been made by our President and by the officers of this Association, in preparing for this Convention. But I do think that the matter of taking liberties with the Constitution is of sufficient moment to require this remark. For that Article of the Constitution there was a very good reason, and it was this: That during the month of August the central station men of the country could best afford to leave their business and attend the conventions of this Association. Many to whom I spoke personally regarding this Convention said that they could not attend for the reason that it came so late. While I have the fullest appreciation of the right royal reception which has been given us by this right royal city, I do protest against the National Electric Light Association, which is a business organization, being misdirected and made solely, or apparently solely, a social or a political organization, or its

Convention being made to mark an international incident. It is not simply with reference to this meeting, but the attitude of this Convention in this matter will seriously impair its strength, I am afraid, in the future. This wealth of hospitality that we are enjoying to-day will act as a sort of incubus upon any city which may seek to entertain us in the future. They will all have the very natural feeling that they should do as well, if not better, than has been done before. I think that in accepting this hospitality we ought to do it with the distinct understanding that if President Huntley desires us to visit him in Buffalo, or if Mr. Wilmerding desires us to visit him in Chicago, they are not expected, in our entertainment, to surpass the precedent that has here been established. I think that as a business organization, composed of business men, gathered for business purposes, there is a line beyond which we cannot go without wrecking the Association.

MR. SEELY: As one of the Executive Committee, I plead guilty to an apparent violation of the Constitution in agreeing to postpone this meeting. But the Constitution says the annual meetings of this Association *shall* be held in February, and that semi-annual meetings *may* be held in August, in each year, at such places as the Association shall determine, and on such days as may be determined by the Executive Committee. I believe that the Association agreed at Providence to hold a Convention here in this city. The date was fixed for some week in the latter part of August, but the hotel people notified us, when we had about made our arrangements, that they could not possibly accommodate us at that time. So it was either a question of adjourning this meeting entirely, or a question of postponing it till one week later. It is a pretty hard matter to assemble the Executive Committee of this Association in New

York City. It costs money to travel, and as they are pretty broadly scattered over the universe, only a few members can be got together to hold the routine meetings; and so we did what we deemed best for the Association. I believe that the Secretary notified every member of this Association of what had taken place at those meetings. Am I correct in that statement, Mr. Secretary?

THE SECRETARY: Yes.

MR. SEELY: There were no objections made by members of this Association to holding the Convention here in Montreal, and they had ample time to appeal to the Executive Committee. I do not care to go further into details.

THE PRESIDENT: Perhaps it is due from me, as the President of the Association, to say something on this subject, although Mr. Seely has gone over the ground very fully. As he has said, hotel accommodations were not to be had during the month of August. Our very enthusiastic friend and member, Mr. Corriveau, was not thoroughly advised when he extended the invitation to come here in August. At that time, we knew as well as anybody could that we were violating the Constitution. But, after coming here, going over the ground, seeing these people, knowing of all the conditions in Montreal, the members of the Executive Committee said: "We will take it upon ourselves, whether it be right or wrong, believing that in so doing we will have best served the interests of the Association." We are in Montreal to-day. We have a Convention. We have an exhibit. And if there is a central station man in the United States who could not have spared one day, to come here and listen to the report of the committee of which Mr. Brophy, Mr. Law and others, are members, and to the other papers which will be read here, then I

must say that he has not the interest of the Association at heart one single bit. It may be due to you, as your President, to apologize for the postponement of this Convention. If it is necessary to do that, I can eat very humble pie. But I think that our work will speak for itself. I will say no more. (Applause.)

On motion, the Association then adjourned to Wednesday, September 9th, 1891, at 10 A. M.

ORDER OF BUSINESS.

WEDNESDAY, SEPTEMBER 9th, 1891.

THIRD SESSION, 10.20 A. M.

1. Announcements.

2. Discussion, "Distribution and Care of Alternating Currents."

3. Paper, "Central Stations Operated by Water Power."

   BY GEO. A. REDMAN, of Rochester, N. Y.

4. Paper, "A Central Station Combining the Advantages of both the Continuous and Alternating Current Systems."

   BY H. WARD LEONARD, of New York.

5. Paper, "Uniformity in Method of Keeping Central Station Accounts."

   BY J. J. BURLEIGH, of Camden, N. J.

THIRD SESSION.

The Convention met pursuant to adjournment, and was called to order (at 10.20 A. M.) by the President, who made the following announcements:

THE PRESIDENT: I am in receipt of the following letter from the Canadian Pacific Railway Company, dated Montreal, September 8th:

DEAR SIR: I beg to offer through you to the members of the Electrical Convention free telegraph privileges for social messages during your stay in Canada, over the Canadian Pacific Railway Company's telegraph; and I am also authorized by Mr. A. B. Chandler, the president of the Postal Telegraph Company, of New York, to extend similar privileges over his telegraph system.

Yours truly,

(Signed) CHARLES R. HOSMER,
Manager C. P. R. Telegraph.

I am also requested by Sir Donald A. Smith to extend an invitation to the members of the Association and their friends—and he wishes me to emphasize "their friends"—to visit him to-morrow afternoon, at his home, from 4 until 6.30 P. M. The Citizens' Committee have arranged a trip down the Lachine Rapids. In the original programme it was designed to stop at the Indian village on the opposite side, but that will be abandoned. We will be back in ample time to accept the hospitality of Sir Donald Smith at 4 o'clock. I hope the gentlemen will all be there, for I am sure it will be a very interesting and pleasant occasion.

MR. STINESS: I move that the thanks of the Association be tendered to Mr. Hosmer and Sir Donald A. Smith.

The motion was carried.

THE PRESIDENT: The first regular business of to-day is the discussion on "The Distribution and Care of Alternating Currents," the subject of the paper read at Providence by Mr. T. Carpenter Smith. To facilitate matters, we will not read the paper now, but, inasmuch as all of you have copies of it, it is now open for discussion.

MR. LAW: While it may have been expected that Mr. Smith's paper would evoke criticism, I must say for myself that I have no criticism at all to make upon it and I heartily concur in all that he has said. All my practical experience has gone to show that. I will, therefore, read a few notes of addition to Mr. Smith's paper, rather than criticise anything he has said in that paper.

I find that Mr. Smith has so thoroughly treated this subject of "The Distribution and Care of Alternating Currents," that he leaves but little to say. I most heartily endorse what he says of the shortsighted policy of the majority of electric light managers in putting up cheap insulation; in other words, the principal point of success in alternating works may be stated in one word, "insulation"; for on alternating wires a short circuit or ground means, as a rule, a burnt-out armature; for I find that, in the most of cases, the dynamo man gets tired of renewing the fuses at the generator, and will put in a 160 or 200 ampere fuse on a machine that is only adapted to carry 130 amperes. I find that the better plan is on a 130 ampere machine to put in a 135 to 140 ampere fuse, and then change it often; not waiting for it to burn out, but change it and put in a new one. By

doing this you keep the machine fused very close to its carrying capacity and the fuse will then go before the armature will become overheated.

Not only should alternating lines be of good insulation, but the primary should in all cases be fused where they branch from the main lines to the converters. In other words, if you follow the insurance rules that have been presented to you for discussion, in primary construction the same as in secondary work, you will find, perhaps, an advantage in it. It is a very common practice to bring these branches directly from the mains to the converters without any protection whatever (other than the insulation on the wire), to prevent contact where one of these wires must cross the primary wires. I have seen a No. 8 wire burn off a No. 0 wire, at the point where the primary loops cross the main lines, and a No. 0 wire charged with a 1,000 volt alternating current is not a very nice thing to have down in the street. Especially should the primary loops leading from the main lines to the converters be well insulated, for, as a rule, they are of small wire, because a large wire is not necessary. These wires are at many times quite long and, being small, they soon get slack, so that a good stiff breeze will twist them together, and unless they are all well insulated they will burn in two the first time they are wet, and they are not pleasant things to meet on a dark night. If proper fuses are placed where the branch joins the main line, it is not only a protection to your machines and converters, but to life also.

When taking charge of a very large station a year and a half ago, I found a great many, I am almost safe in saying *all* the primary fuses were removed from the converters, and No. 14 copper substituted, simply because they sometimes blew out. Now, a properly placed fuse does not blow out unless there is a cause for it.

There is the greatest of danger in not having the primary wire fused before reaching the converter, although there is a remarkably small number of burn-outs in converters; yet when it does occur, there is a danger of the primary wires becoming connected with the secondary and you have a 1,000 volt current at your lamps. All converters are so built that a contact between primary and secondary coils is almost impossible, but if by a short circuit in your primary it receives a current of from 50 to 100 amperes, when it is only adapted to carry from one to five amperes, thus causing it to overheat, it will burn any insulation which may be used. This is very liable to cross the primary and secondary wires and you have all the dangers of a high electromotive force clear to your lamp socket. Properly fusing the primary wires will effectually prevent all this danger.

One weak point I find in alternating central station construction is the double throw switches; they are never large enough to break the arc, which they are sometimes required to do, for it is not only to break the usual load of from 50 to 75 amperes on each circuit, but, in case of a short circuit or ground, it may reach three or four times that amount, and the fire and noise produced in a break of that kind are only realized by those who actually perform the operation.

Likewise, the fuses are not one-half large enough to break radially. These fuses are generally placed on the back of a wooden switchboard, and are a great source of danger from fire. (Applause.)

THE PRESIDENT: Is there any further discussion on the paper? I trust that the gentlemen will remember that this paper is a very important one, and was so considered at the Providence Convention; so much so, that it was the first paper in the history of the Convention that was left for discussion at another Convention and

there ought to be a great many of our members able to say something on this paper and I should regret very much if there was not a very generous discussion of it by nearly every member here. It is one of the most practical papers that has been read before the Convention. It affects, I think, every member of the Convention. I would be glad to hear from Mr. Burleigh, if he would say something in connection with it.

MR. BURLEIGH: I do not think I am competent to discuss this paper. It is an exceedingly interesting one; I have read it very carefully, and I have found it a very great help to me in the arrangement of my plants. I have adopted a great many of its suggestions. I do not know that I have any criticisms to make upon it, or any special comment to offer.

MR. FRANCISCO: On pages 261 and 262 you will find that Mr. Smith refers to overhead and underground wires. Now, in the work in which I have been engaged for the last six months, with regard to this underground business, I have had a chance to meet this point of overhead and underground construction very generally, and my experience is that one-half of the trouble we have had in regard to underground and overhead work has been from the loose, miserable manner in which the overhead wires were put up. If the electric light companies themselves had thoroughly installed their system, and run their wires in a proper manner, spending, perhaps, what they have for underground work, we would not have had one-half the trouble we have at the present time. In several cities I have visited in regard to this underground business, the officials themselves have said: "Why, if you people would put your wires overhead in proper shape, we would not have commenced this raid. But here are these wires strung in a slip-shod, haphazard manner, without any system or care, and in many cases

without any real insulation, and, of course, we have to protect the public. We are here as officials to protect the public and, naturally, if you people will not take the initiatory steps to protect the public, we must compel you to." Many officials have told me that that was the reason of this raid, and I am satisfied that if the electric light companies would even now—of course, in certain large cities there is no question in regard to what should be done—you have got to go underground anyway, whether it be practicable or not—but in a large proportion of the cities you will find that if you will properly construct your lines, put them in proper order and keep them so, you will have no difficulty with the city authorities. I say this after having interviewed a large number of the city officials of different places. You will notice that Mr. Smith takes the same ground in his paper, and it is one of the best and soundest doctrines that has ever been promulgated in this Association.

There is one other point here that Mr. Smith speaks of, in regard to lights running on contract and meter. The human family are very peculiarly constructed and my experience in electric lighting business has been that a man who wanted light 24 hours in the day right through, when he made his contract, never expected to use that light more than an hour and a half or two hours during those 24 hours. That was the universal basis upon which he made his contract. There was no occasion whatever for the light more than two hours. No matter how close you bring your contract down, no matter how many patrols you run around, it does not make any difference. I have myself passed the establishments of men to whom I was furnishing light under contract for a certain number of hours. I have passed their places four or five hours after the time expired for their light to be extinguished, and the lights

would all be going. On one occasion I walked into a man's establishment and the lights were burning. I looked around the establishment; he had the whole place illuminated. He said: "Is anything the matter?" I said: "No; nothing at all; I wanted to see how these lights were burning. They seem to be running very fine." He looked at me, and he happened to think that it was after the time that they should be running. "Well," he says, "I happened to step in here to-night to turn them off." The next night I passed there at the same hour and he happened to step in and turn them off. I followed that up for about a week and I noticed he happened in there every night and he stayed there every night until 12 o'clock. Of course, if you charged that man for extra hours, you would have trouble at once; but with this meter on, you can tell the man distinctly: "You may burn as many hours as you please; you simply pay for what you use;" and that is all there is of it. That is the true basis of all electric light business, I think, to have a meter and control your business absolutely in that way. Now, I hold, as I said at Providence, that this paper should be thoroughly discussed, because it is one of the most practical papers we ever had, and it is at this time that practical instruction is valuable to this Association and its members; especially to central station men. That is one thing I come to these conventions for, to get just such information as this, and to save expending hundreds of dollars in testing the different theories. I prefer to come here and get the experience of others who have tried these things, and then I avoid the rocks on which they foundered and I do it without the trouble and expense that they incurred. I have in my own experience a case that came up in one of our conventions. A gentleman got up—I think it was Mr. Law—and mentioned a point in regard to some matter. I

had just entered upon the very drive that he stated to be out of place, that could not be carried out, and a thing that would be a loss to anybody who attempted it. Immediately after that, I went to the telegraph office and telegraphed to the man to stop work on that thing, and when I got home I said, we will abandon that. I saved several hundred dollars by that operation; I got it here by Mr. Law's suggestion of a little point. If all the central station men would come here, and bring these practical papers before us, they would find it would save them hundreds of dollars; and that is just what this Association is for. (Applause.)

MR. LAW: I will state a little circumstance respecting one of the methods of keeping meters. This I hardly believed at the time, but I traced it down to find the truth of the matter. The man had pried up the cover of the meter sufficiently to introduce three or four spiders. A few spider webs in there were all that was necessary to retard the meter. I traced this matter down and found that he had actually pried up the cover and introduced the spiders.

MR. FRANCISCO: Mr. Law's little remark on that reminds me of a thing that occurred the other day in my experience. I found that this plan of prying up the meter was adopted. I applied a small wire so that when he pried up the meter and had a short circuit he never repeated it.

MR. AYER: In Mr. Smith's paper I see no allusion to what seems to me a question as to the location of the cut-out and fuse. Some of the manufacturers take the position that those things should be separate from and independent of the converter, and left on the outside, and should not be incorporated in the converter box. We know that the practice with others is to put them in. I am particularly interested in the experience of

those who may have it in both ways, because I am about to add a large incandescent alternating plant department to the station, and I have not had this experience with them. It seems to me it is a matter well worth taking up, because there is a very decided stand taken upon it by different manufacturers, and I would like to raise that question.

MR. T. CARPENTER SMITH: I would say, with regard to the placing of fuses in converters, that our experience has been that, as a rule, there is little trouble with the primary fuse in the converter, except when you want to replace it. It is usually a very ugly job to replace a primary fuse in a converter. We have, for a good while now, left the secondary fuses out, and we have always followed the practice of putting a cut-out immediately at the converter, and we found that we had a great deal of trouble with the secondary fuse, from the fact that it is a heavy fuse and the contacts are not large enough. It is difficult to get contacts that will last three or four months without being corroded. We, therefore, put copper in those fuses, and depended entirely on the cut-out which is immediately outside the converter. On the primary, in some cases—for large buildings—we put cut-outs on the pole, and still kept the fuses in the primary end. But we had very little trouble with the primary fuse, except in the case of short circuits, in which case the primary fuse always went. We never had any trouble with a short circuit from the blowing of the primary fuse, but I believe others have had that trouble, with the primary terminals being so close together when the fuse blew, the lead vapor would not cross. There are converters now made in which the primary fuses are put on a separate plug, and that plug is pushed in and can be taken out, and the fuses replaced, without touching any high tension wires or

connections, with the current on. That has another value, which is that the fuses, if required, can be soldered into the plug, and spare plugs can be kept on hand, while a lineman can go around once a month, or as often as is thought necessary, and by working the plugs he keeps the contacts clean, and works off any corrosion that may be in there, and keeps a great deal of heat out of the fuses. That form of connection I spoke of—about having some arrangement made by which a fuse on the feeder should be on a switch, so that the switch could be worked for keeping the contacts clean without cutting the current off—that is a point we have to keep clearly before us, that incandescent light, to succeed, must be as continuous as gas, and, while a customer will not object to a wink in his light, he will very strongly object to the light being out for four or five seconds. If the light merely winks on the changing of a switch, he looks up and the light is steady again, and he thinks perhaps he was mistaken, and does not take any further notice of it. But in a large house, where large quantities of goods are handled, it is very awkward to have the light stop four or five seconds.

MR. AYER: The point that I wanted to get at is leaving the cut-out and fuse outside the converter box. It, perhaps, has some value in a short circuit coming on the loop. Bringing about a short circuit will only blow the fuse which is placed in the cut-out of the pole, where, in the event of the cut-out being incorporated in the converter box, the primary fuse would undoubtedly blow a fuse in the main feeder, also leaving a dangerous condition of affairs on the wires. Manufacturers regard this as of some practical value. They make a point of it in their literature, and indicate that it is preferable to keep the cut-out or switch in the fuse out of the converter box. The cost of construction is very much greater

where the separate box is used, and it is a question whether it is desirable, of course, to obviate this danger of short circuiting on the loop. The converters may be placed on the pole and there is room for cut-outs; that would place the fuse at the point where it would be a protection to the public as well as to the feeders. But I do not see the utility of separating them. There are two devices there, a cut-out and a converter; there are boxes which contain them. It seems to me that the one box should contain the two devices, and they could be so arranged as to do it properly. It is much more expensive to install, as well as to buy. Different manufacturers take different views; some favor incorporating it in the converter box with the converter, others leaving it out. There is no special reason why one company should not put them out, unless they saw an advantage in it; there is no patent which would prevent their incorporating it in the box. That being true, it seems to me it is a good thing to know; it makes quite a difference in the cost of installing the lights.

Captain Brophy: I have had some occasion to look after the installation of electric light wires, and I found that while one party was endeavoring to convince the public that the alternating system was a menace to their lives and property, those who were installing contended for the opposite. I found that the installers of transformer systems were really cutting their own heads off by increasing this danger themselves. I frequently found wires in the primary and secondary sides of the transformer, instead of the fuse—not in one case, but in hundreds of cases. The cause of this was the electrolytic action that takes place in the transformer, which causes the fuses to give way. The transformer, when placed on a pole, or on the outside of a building, as you know, is exposed to the weather, and subject to extreme

changes of temperature, and condensation takes place on the inside in those cases. The lineman is sent out on a rainy night to replace the fuse. He thinks that this copper wire would save him a great deal of trouble. An accident occurs. The man who makes the connection leaves a little end projecting out in contact with the shell. If a person takes hold there, and the conditions are right, we have an accident—we have more than one. Now, for that reason, I believe that the fuses should be placed in the transformer, so that this will not occur; but they should be so placed that they are not subject to these changes; otherwise you will find in many of your transformers wires where fuses ought to be. (Applause.)

MR. SCOTT: There are troubles in converter fuses, even when they are carefully watched all the time. About two years ago we had one converter that was persistently blowing its fuse. I told the lineman to bring it to the station. The base under the screw head of the connection showed a mark indicating that the fuse had melted there. The screw had become loose, either by the swaying of the pole, or the humming of the converter; I have never been able to determine which. The vibration of the screw had formed an arc which had melted that fuse. The brass had become red hot and the switchboard below it was completely charged for half an inch behind it, so that the screw and its base were ready to fall through. After that, we made our lineman go through every thirty days, and examine our fuses. With secondary fuses, I have never known of an accident from one blowing during a thunderstorm. Sometimes a whole loop of 18 or 20 converters will have their primaries blow. People are tempted to get small sizes, on account of economy, and place them on a line where they have three or four lights to supply. For instance, a five light converter will be put up. The line-

man comes along, and finds that the fuse wants attention; he has a ten ampere fuse in his pocket and he puts it in. During a thunderstorm, the lightning, or the static electricity on that line, attacks that converter, and it finds it easier to burn out that No. 20 or 22 wire than to burn the ten ampere fuse. Consequently, the primary coil is gone and the converter has to be taken down. Those troubles with the coil are generally six inches or a foot from the beginning of the coil. I once sent to Pittsburgh for a coil for a Westinghouse converter, to replace the primary coil, and afterwards unwound the old coil to see where the trouble was. I never found an instance where the lightning traversed the complete circuit. If the coil is attacked it will be broken before it has taken the complete circle, and, by just taking off the tape and paper, that can be taken out and the converter will work just as well. I do not see the use of buying primary coils to work after the old coil is broken.

About a month ago my attention was called to a new lightning arrester. I took my lineman to the place in Philadelphia where a company had equipped its line with the lightning arresters and I found that after equipping the line with them they had 47 twenty light converters going after the 21st of July. I did not buy those arresters. I looked at the inside of them and found what you might call a puddle of brass around the bottom of the connections. There are transformers which have the primary and secondary fuse connection both on a wooden block inside a sort of box. If the primary fuse is attacked, the secondary is bound to go. The short circuit is so complete that it burns the wooden block and the whole inside seems to fall down. But by sending a man around at least once a month to tighten up the screws under the fuses, or to replace the fuses where they show any oxidation, and keep them in good order,

I do not think there is any trouble with them. I do not feel inclined to pay for a twenty light converter when I have three lamps to install, on account of the lightning altogether.

MR. BLAXTER: I quite agree with Mr. Francisco in thinking that the trouble we have had has been due to bringing in a class of consumers who have a large number of lights with very small usage. As you all know, there is a certain amount of leakage in all converters, and where a man in a residence installs 100 sixteen candle power lamps, and uses, perhaps, but ten or twelve of them for two or three hours each evening, the profit is entirely absorbed in the energy which is used up in the leakage; and some system should be devised so that the man in charge of the central station can in some way balance or compensate for this leakage. We started in by adopting the method of a guaranteed usage and if the actual usage is under that guarantee, we charge it according to the guarantee and if the usage is over that, we charge it in the same way. This seems to be rather an arbitrary plan, but, so far, it has worked satisfactorily, and has helped us out considerably.

MR. T. CARPENTER SMITH: With regard to Mr. Blaxter's experience, as to leakage on the series in large installations eating up the income, I would suggest that the meter manufacturers should be encouraged to get up a meter which could be placed on the primary side of the converter, and let the customer pay for the leakage. He will then keep the number of lights that he is going to install down to those which he will actually use, and he will keep his converter capacity down, as soon as he understands that he has to pay for whatever leakage there is.

THE PRESIDENT: Will Mr. H. Ward Leonard give us his experience with converters?

Mr. Leonard: My experience in converter practice is largely in the future. I hope that I shall have a good deal of it, but my experience in the past, and my knowledge of it, is largely derived from the remarks I have heard from members of the Association and from what I have read on the subject.

THE PRESIDENT: If there be no further discussion on that subject, we will take up the paper of Mr. George A. Redman, of Rochester, N. Y., entitled "Central Stations Operated by Water Power."

CENTRAL STATIONS OPERATED BY WATER POWER.

BY GEO. A. REDMAN, SUPERINTENDENT BRUSH ELECTRIC LIGHT COMPANY, ROCHESTER, N. Y.

Mr. President and Gentlemen: The purpose of my paper is more to give a description of what is being done with water power for electrical purposes in the City of Rochester by the three different electric light companies doing business in that city, and some of my own experience with water power, than to take up your valuable time with the technical description of turbines, which can be gleaned from any of the numerous catalogues of turbine manufacturers, which contain full descriptions of turbines and their construction.

The adaptation of water power for electrical purposes has grown very rapidly within the past few years; there are several causes operating to enhance the value of water power, none more so than that of electricity.

Streams that have had no pecuniary value heretofore are now being utilized for the purpose of running electrical machinery, yet at the same time the supply of water is diminishing, caused by the destruction of forests, and water right owners in various parts of the

country are devising means of storing water during the rainy seasons to furnish a supply during the dry season; also storing it in the daytime for night use. One large water right owner in Western New York, during the months of July and August, places flash boards two and one-half feet high on top of his dam, at an expense of $100, and stores up for night use the water which is not necessary for him to use in the daytime, thereby saving in the two months a coal bill of $2,100.

The Johnstown, N. Y., Electric Light Company have improved their water power at the Cuyadota Falls by erecting a dam 34 feet high on top of the falls, giving them a total head of 75 feet and nearly doubling the amount of power.

A survey of the upper Genesee River, between Mount Morris, N. Y., and the celebrated Portage Falls, has been made during the past year for the purpose of establishing a reservoir that will furnish the City of Rochester 30,000 horse power more daily during the entire year than they have at present.

The earliest forms of water wheels were the paddle and flatter wheels that only utilized the impulsive action of the water; these were followed by simpler wheels of the reaction type and others.

We now have the improved forms of the Leffel, Victor, Lesner, Success and many others. There is a demand for the best and most economical turbine that can be manufactured.

Turbines should be built to secure the delivery of the water upon the turbine without checking the velocity of the water more than one-third, and permit the free discharge of same after passing through the turbine, and to work with as good efficiency under part gate as under full gate, and to be made of the best phosphor bronze, to stand the wear and tear under high heads.

It is essential, in locating central stations to be run by water power, to locate them where there is no great danger of a flood, or so protected by a breakwater as to make it perfectly safe, and also to avoid trouble with backwater upon the turbines.

Where a station is situated on the bank of a river it is best to take the water from the river by means of a raceway, with the headgates parallel with the flow of the water, and at times of a freshet or running of anchor ice, it will more than pay any expense incurred by so doing.

The raceway should be of a sufficient depth and width to permit the water to flow not more than 90 feet per minute, and a waste gate should be placed in the side or end of the race to use in case of emergency; and when cleaning out the raceway a rack should be built across the race to prevent driftwood and other rubbish from passing into the turbines.

For that purpose I would recommend a rack built of iron slats two inches wide, one-eighth of an inch thick, and placed five-eighths of an inch apart on seven-eighth inch iron rods, at an angle of 45 degrees. Particular attention should be taken to keep the rack clean by raking. A trough or platform should be placed over and immediately back of the rack to rake the rubbish and anchor ice into, and so arranged that a current of water from the race will pass through the trough and carry off all of the rubbish, etc. For any station that is using 100 horse power or over, it will be a great saving in labor to them, and pay well for the extra expense. For winter service a boom should be placed in front of the headgates, and the current will carry off a large portion of the anchor ice and other floating objects.

The headgates should be built to work with a rack and pinion; also a roller should be placed back of each gate stem to facilitate the handling of the gate.

The gates should have a protection built over them, to protect the gearing from the storm. In a cold climate, where the gates are apt to be frozen in, salt is essential in freeing them from ice. All headgates and timbers should be of the best quality of oak, and should be well bolted, and not less than two gates to one raceway. The tail race should have not less than two to three feet of dead water when the wheels are not in motion.

Where the tail race runs under the station, cement floors should be laid to prevent moisture in the station; a floor of that material will soon pay for itself.

Vertical turbines should be placed so that the steps are covered with water at all times. In adapting turbines to very high heads, or to conform to location, it becomes necessary to set the turbines above tail water, and conduct the water away from the turbines, through a draft tube; the same depth of pit and area of discharge is required where a draft tube is used, as would be when the turbines are set at the bottom of the fall; the mouth of the draft tube should always be submerged about six inches in standing tail water. It is claimed that draft tubes can be used 30 feet in length. I do not think a draft tube more than 18 feet in length should be used, on account of the difficulty in keeping the tube air-tight, for if the tube leaks, the vacuum is imperfect and there will be a great loss of power, and where steps are used they will be apt to be burned out.

When possible, I would advise horizontal turbines to be used, as they are easier taken care of, and many of them are used without any steps. The burning out of steps is an expense and annoyance. One of the greatest advantages in the horizontal turbine is that the dynamo can be belted direct to the turbine shafting, and is in some cases coupled direct to turbine, making a good

percentage in economy in power and avoiding the use of gearing, and I deem it advisable to put in a number of small turbines, instead of one large one; in case of a break down, they are more easily repaired and cause less delay to customers.

In the old station of the Brush Electric Light Company, of Rochester, the vertical turbines caused considerable annoyance in the burning out of steps and stripping of the gears; so much so, that it became necessary to support the vertical shafting with water cushions. For wooden steps we have had the best success with *lignum vitæ*.

In my opinion, governors for the turbines are necessary and will govern any slight variation of load under high head; but where one-third or over of the load is thrown off or on suddenly, it is necessary to handle the gate by hand, as under the above circumstances the turbine is apt to slack down or run far above the normal speed, as the case may be; in the latter case causing the burning out of lamps and armatures. The governors should be placed as near the turbines as possible, to save lost motion in the gate shafting and avoid the use of gearing as much as possible.

We have two governors in use in our office building under a low head of 16 feet, and they govern the turbines under all circumstances in quite a satisfactory manner.

The decided advantage of a water power station over one run by steam power is not only one of economy in the saving of the expense of coal, but the station and apparatus can be kept cleaner and cooler, thereby saving considerable in expense of repairs; and it is also far more pleasant for the employés.

The Brush Electric Light Company, of Rochester, purchased the entire lower falls of the Genesee River

(which is about two miles from the business center of the city) some nine years ago; at that time it was looked upon by many as a piece of folly to think of running dynamos there, on account of the distance from the business centre of the city and the dampness around the Falls. Notwithstanding the adverse opinions, they erected two buildings on the west side of the river above and near the brink of the Falls, and put in two 30½ inch Leffel, two 20 inch Victors and one 40 inch Leffel turbine, the first four mentioned turbines under 94 feet head, and the latter under 28 feet head, with a total of 2,500 horse power. After running this power for five years they built a new station and leased their old power to different parties for pulp and flour mill purposes.

The new station is a three story stone building, 45 feet wide and 90 feet long, with a two story brick addition 42 feet wide and 80 feet long, and located at the foot of the Falls on the east side of the river. The turbine capacity consists of 15 double 15 inch horizontal Lesner turbines under 90 foot head, with 14 foot draft tubes, a total of 3,360 horse power, using 6.95 cubic feet of water per minute per horse power; have had but one turbine damaged to any extent in four years. The turbine casings are placed on iron girders with the ends of the girders resting on solid rock.

The amount of floor space occupied by all of the turbines is 4 feet by 38 feet; the weight of each turbine is 196 pounds, less than one pound to a horse power; each turbine is placed in a separate division of the casings and the shaftings extend through the shafting room, upon iron bridge-trees, with seven feet and six inches between journals, and the dynamos are belted direct to the turbine shafting; the shafting runs at 800 revolutions per minute, with 25 inch pulleys on the turbine shafting and 24 inch on the dynamos; we use untried beef tallow for

lubricating and are well satisfied with its results. The turbine gate shafts and governors are placed in the dynamo room at an average distance of 14 feet from the turbines, where they are easily handled by the attendants. A tell-tale is placed in the shafting room, connected to a float in the race above the Falls, which shows the height of water in the race at all times.

The water is taken into the raceway about 80 feet above the Falls; the race is 32 feet wide, and five feet six inches deep, and cut through the solid rock; there are four headgates with a house built over them; a wooden diagonal rack is placed in the race near the spillway to assist in freeing the race from anchor ice; the spillway is six inches deep and 32 feet long. The waste gates are placed next to the spillway and are three feet six inches wide; there are two of them. In front of and near the top of the penstocks an iron rack is built according to dimensions given; also a rubbish trough.

There are three iron penstocks, six feet in diameter and 80 feet high, built of three-eighth inch boiler iron, with a gate to each penstock.

There are five elbows to each penstock, leading to as many turbines, with an iron slide gate to each elbow; in addition, each turbine has a register gate, thereby permitting the repairing of any one turbine without interfering with the running of the others. A turbine can be taken out and another put in its place in 25 minutes.

Cement floors are laid in the shafting and turbine rooms.

There are three tail races, extending under the entire length of the main building; each race is nine feet wide and six feet and six inches deep.

As a reserve power, when making repairs and cleaning the raceway, we have a 600 horse power Cooper-

Corliss engine; in the past year it has been necessary to use it but a few days.

For fire protection, two-inch iron pipes are run from the penstocks through both buildings, with four lines of hose attached at all times; the hose is tested once a week; in addition to the hose, a dozen fire pails filled with water and placed in different parts of the station are kept in readiness, and are not permitted to be used for any other purpose.

A record is kept of the time of starting and stopping of each turbine, also the speed and load on same, and any variation in height of water, and all repairs that are made. In addition to the above records, the day and night wheelmen report the condition of the power at the time they are relieved.

There are nine men employed at the station, five of them in the dynamo department and four in the water power department.

We have in service 30 dynamos; three of them are run without any stoppage and the balance of them on an average of 13 hours per diem.

A record book is kept in the dynamo room, in which entries are made of the time of starting, stopping, speed and load of each dynamo; also all repairs of every description, all accidents to either machinery or circuits, nature, time and cause of same.

All the circuits are tested five times daily, and the tests and time of same entered in the record book.

By the means of water power the company is enabled to furnish cheap and satisfactory light and power at the following rates, viz.:

City arc lights, all night and every night, 27 cents per night; Commercial arc lights, all night and every night, 40 cents per night; Commercial arc lights, evening, 25 cents per night; Commercial arc lights, evening and all

day, 40 cents; 1/8 horse power motor, $18 per annum; 1/2 horse power motor, $48 per annum; 1 horse power motor current, $72 per annum; 2, 4 and 6 horse power motor current, $50 per annum, per horse power; 8, 10 and 15 horse power motor current, $40 per annum, per horse power; 1/8 horse power fan motors, $15 per season, from June 1st to October 1st; 16 candle power incandescent lamps, $5 to $12 per annum; 25 candle power Bernstein lamps, $12 per annum; 50 candle power Bernstein lamps, $24 per annum; 100 candle power Bernstein lamps, $48 per annum.

The rates I have mentioned are for arc circuits; our rates for current on 500 volt constant potential circuits are as follows, viz.:

One horse power, $48 per annum; 2 horse power, $96 per annum; 5 horse power, $180 per annum; 8 horse power, $240 per annum; 10 horse power, $300 per annum; 15 horse power, $450 per annum; 20 horse power, $600 per annum.

We operate a total of 832 motors, of which 196 are fan motors, 1,396 arc, 135 Bernstein and 200 Swan incandescent lamps. One motor circuit contains 26 miles of outside wire and 394 1/8 horse power C. & C., one 2 horse power and one 4 horse power Brush motors, and is run with a No. 8 Brush arc dynamo. We have one 40 kilowatt 500 volt C. & C. generator in service, on an eight mile circuit, with 48 horse power in motors in use; the ammeter averages 29 amperes. We experience no difficulty in running same with our power.

The rebate for poor service during the year ending December 31, 1890, was one one-hundredth of one per cent. of the gross receipts, and the uncollected accounts for the same period was one-tenth of one per cent. of the gross receipts.

The Edison Electric Light Company have recently erected a three-story stone station at the foot of the upper Genesee Falls, on the west side of the river, and have at present two double discharge Leffel mining wheels under about 90 feet head, giving 600 horse power, and are placing two more of 400 horse power each. In addition, they have a fine steam station in the centre of the business district. Incandescent 16 candle power lamps are furnished at one cent per lamp hour; arc lamps for city use, 28½ cents per night; municipal incandescents at six cents per night. The latter they are partially replacing with arc lamps. They have in circuit 105 arc, 805 municipal and about 13,500 sixteen candle power incandescent lamps.

The Rochester Electric Light Company's plant is situated at the upper Genesee Falls, on the east side of the Genesee River, near the business centre of the city.

The station is three stories in height from the top of the Falls, with the wheel pit underneath, blasted out of solid rock 95 feet in depth. They have five Leffel horizontal turbines; four are 23 inches, and the other 30½ inches in diameter, with a total of 1,500 horse power, under a head of 86 feet and 8 inches.

The penstock is a steel pipe seven feet in diameter; the power is transmitted to five shafts 80 feet above by belts 173 feet in length, running at a speed of 7,200 feet per minute.

The dynamo room is directly over the shafting, from which all of the dynamos are belted through the floor. The dynamos are the United States system.

They have in service 325 city arc and 140 commercial arc lamps; also 1,500 incandescent lamps and two 10 horse power motors. They have just placed one 85 horse power generator and one 1,500 light Westinghouse alternating dynamo.

As a reserve power, they are putting in a 400 horse power engine. The city lights are being furnished at 27 cents per light.

In addition to those I have mentioned, there are five incandescent plants and one arc isolated plant run by water power in Rochester, some 500 incandescent and 25 arc lamps, making a grand total of 1,991 arc and 16,640 incandescent. The population of Rochester is 135,000, making a very high average per capita.

DISCUSSION.

MR. REDMAN: In this paper I have given a description of what is being done in Rochester and I would like to call the attention of members to the prices given. They vary, undoubtedly, from the prices of some other cities, but you want to bear in mind that we use water power entirely. It has only been necessary during the past year to shovel coal for half a day, and that necessity was occasioned by the cleaning out of the raceway. Another thing to which I would call particular attention is the development of the motor service. We have two motor services; one running in the northern portion of the city, and the other in the northwestern, where, with very few exceptions, the motors are placed in dwellings, or in small shops built in the rear of dwellings. Heretofore, the small manufacturers resident there have done business in the centre of the city and on the fifth or sixth floors of buildings, but now they do their manufacturing at home, either in their dwellings or in small shops. As a boss tailor remarked to me the other day, when he did his work down in the city he only worked himself, "but now," said he, "mein frau and all the children work."

I shall be glad to answer any questions you may ask with regard to the subject.

MR. ARMSTRONG: How much money do you make?

MR. REDMAN: That is rather a leading question. We pay a dividend.

MR. ARMSTRONG: What I mean by that, of course, is, do you make unusual dividends from these rates and can you carry a large sum as surplus, or are you only making fair dividends?

MR. REDMAN: We are making some money. Of course in addition to our electric light business, we are renting water power for other purposes. We are renting 2,500 horse power of water power.

MR. ARMSTRONG: My question was with relation to your selling light and power.

MR. REDMAN: We have not lost anything yet.

MR. FOOTE: Which branch of your business do you consider the most profitable; the power, or the light?

MR. REDMAN: We are now developing the power, and making special efforts with it. The incandescent light we hardly bother with.

MR. ARMSTRONG: My question was addressed more particularly to the data contained on this page, that we might have some explanation of it which would enable us to use it practically. My object was to get information which would enable us to make use of these figures ourselves. I presume there is no company here but has had Rochester and other cities (I will not name them, for you know the whole list) thrown at them by members of city governments and boards, whenever propositions have been made by electric light companies for municipal lighting. Now, we get thirty-nine cents for 2,000 candle power lights every night, and all night, while here the price is stated by Mr. Redman to be 27 cents for city arc lights. I see that for com-

mercial lighting, every night and all night, 40 cents per night is obtained by this company, which has to use coal for only half a day during the entire year. The facts shown by these figures, as they go out, ought to be strongly emphasized, but the fact ought to be just as strongly emphasized that nothing but water power is used by this company. And the further fact ought to be emphasized that, in addition to the fact that the water power costs nothing, so far as the electric light is concerned, 2,500 horse power is sold. So that the incidental expenses, as I apprehend, and, possibly, the investment itself, is paid for by the sale of water power in addition to the sale of electric lights. Rochester, therefore, is doing a great thing when it is so far underselling those of us who have to pay high prices for coal and who have to watch our boilers and our coal fires very carefully. Our General Manager, when he has met the lighting committee of the Common Council, has had urged upon him the figures of this city, and the figures of other cities using water power, as well as the figures of cities that burn coal, getting it for nothing, and objecting to pay for the carting.

MR. REDMAN: You will notice that two other companies charge the same price. There are three companies doing business there.

MR. ARMSTRONG: And, practically, you get the same price. Are they also using water power?

MR. REDMAN: Both water and steam.

MR. ARMSTRONG: My purpose in rising was simply to call attention to the fact, and to impress it upon your minds, that these differences in figures are owing to the fact that the water power furnishes the original power at almost if not nominal cost. And another thing: Let us be very careful to give all the facts connected with the production of power, when we give out the figures that

we receive for our output. It may be that a company getting 70 cents—or possibly I am rather too high; but getting a large percentage above what our own company is getting—is not making the same amount of money, because the cost of fuel, and other conditions, may be much more serious for them than they are for us. We may be making less money than a company getting considerably less than we are getting, simply because their conditions may be much more favorable than others; but if we can get statistics and information in such a way that all the conditions are always given, we will be doing well. I am glad that in this paper the conditions are given so plainly as they are. I only rose that I might emphasize with our members, and emphasize with the authors of any other papers upon this subject, the fact that we want these things brought out just as fully as they can be, because what we say here is not only for ourselves, but it goes out to the public.

MR. FRANCISCO: I would like to ask a little information with regard to some of those points. I notice that the writer says that a one horse power motor current costs $72 per annum, while a one horse power costs $48 per annum. Why is this difference?

MR. REDMAN: We claim that it produces much better than that with a constant potential generator.

MR. FRANCISCO: Another question as to this horse power motor: Do you make any difference with regard to the business you are running?

MR. REDMAN: No, sir; not unless it is used for ventilating purposes. Where a one horse power motor is used for ventilating purposes we get $120 for its use.

MR. FRANCISCO: Do you make any difference with regard to the time they run; or is this for constant service?

Mr. Redman: It is for constant service; they can use it or not.

Mr. Francisco: You do not use any meter with those?

Mr. Redman: No meter.

Mr. Francisco: My experience is that there is a difference in the business. I am running at the present time a 30 horse power motor—running an entire factory with that motor. In that factory they have a Daniels' planer, and that takes 44 amperes to run. They are running the whole factory with a 30 horse power motor. When they first started, I could not understand what was going on down there. They would throw on the 44 amperes of current, while their motor was not intended for such an arrangement.

Mr. Redman: We are running some Daniels' planers, and I find in our experience that those planers are the worst machines to handle.

Mr. Francisco: I went down and investigated the matter, and found that it all depended upon the way they were running that planer. They would set it for a quarter-inch strip, and put on the 44 amperes; whereas, if they would set it for an ordinary cut, it would only take 40 amperes with a 500 volt current. We were running a 500 volt current on that machine. The point was just here: that, in doing their planing, if they took only a thin shaving, they had to run the board through twice; whereas, if they took a thick shaving, they run it through but once, and it took but half the time. The result was that human nature developed itself at once.

Mr. Redman: Why did you not put your meter on?

Mr. Francisco: We had a meter on; there was where the kink came in; we charged 25 cents per 1,000 watts.

MR. REDMAN: Was that regardless of the hours in which they were burning the lights?

MR. FRANCISCO: It makes no difference; they can burn as long as they please. They cannot burn them without consuming watts.

MR. REDMAN: Do you charge 25 cents per 1,000 watts for daylight only?

MR. FRANCISCO: If the consumer has a meter on, the charge is 25 cents per 1,000 watts. We charge the same rate for light and power, 25 cents per 1,000 watts. But we have found, in respect to its use for power, that there is a vast difference in the kind of business in which the power is used. We are running a motor for a daily paper. They used to run that paper with water power and a steam engine, and it took them four or five hours to run off an edition of the paper. We started in, and they supposed it would take them the same length of time to run off the edition with our motor that it did with the water power and the engine, and we based our contract upon that supposition. They have found since they put in our motor that it requires just one hour and ten minutes to run that edition through, instead of four or five hours. Our contract, however, was based on the experience which they had had with water power. They only use the motor while that edition is being run off, for the one hour and ten minutes; whereas, in another class of business, as in running an elevator, they will run the motor through ten hours of service. In one store, they are running a passenger elevator, a freight elevator, a cash system and a coffee grinder, all with the same motor, and they are running it for ten hours. They run it under a contract. If we charged for horse power at so much for ten hours service, of course, in that case, we would lose, whereas, in another case, where we charge by the horse power, the motor might not be in

service half the time. So you see that there is a vast difference iu the employment, so far as the motor business is concerned. It all depends upon the business they are doing. We are also running a freight elevator in a store, which is run on a meter. In the first place, the man was afraid of the meter, and said that he would prefer to make a contract for a specified sum. He said that he had had some experience with meters, and, by the way, he is a director in a gas company. (Laughter.) He said, "I have had experience with meters and I will not take a meter." Said I, "Very well, we will give you a motor on contract." He said that that was all right. So we made a contract with him for the motor, but, for my own information, I put the meter in. At the end of the first month, he paid his bill according to the contract. When I went there to look at the meter at the end of the second month, he said: "Of course it is nothing to me, but how much does that meter indicate? how much would it have cost me, supposing that I had been running according to that meter?" Said I, "Do you really want to know for your own information, or do you want to know for the purpose of applying it on the contract?" He said, "Of course I cannot apply it on the contract until the end of the year, but I would like to know for my information," Said I, "It would cost you just one-third of what you are now paying. If you had paid by the meter your bill would have been just one-third of what it is now."

Mr. Redman: What did you charge him?

Mr. Francisco: I charged him $60 per year for a five horse power motor. I find that as to other classes of business it is the same. I find that a job printing office is one of the worst possible places you can get into. You cannot run motors in different classes of business for the same price per horse power. I am

referring, of course, to steam power; if you have water power it is quite another thing. That is why I am anxious to get out all these points, and why I want to know whether it is calculated upon a ten hour service, or upon the ordinary run of business. In the case of this man, I am getting just three times as much on the contract as I would get on the meter; still, I would rather have the meter. I told him the other day that I would change his contract, and charge by meter, if he so desired. And I will tell you the reason why: If you have a meter, you know just what you are doing; you know that the man is paying for just what he is using, and for no more. Then you can make your calculations on your business. You know you are giving him a legitimate and straight business, and the man will be satisfied to be charged by the meter, even though he has had an experience in the use of gas meters. (Laughter.)

This is no reflection at all upon gas companies, but I would like to state a little experience that I have had in my own house. When I went to Europe, I locked the whole house up, after I had turned off the gas at the meter. I was gone all through the summer and came back late in the fall. A few days after I returned the gas collector came into my office and said: "Here is your gas bill. You have been away from the office and I have not been able to present it." I glanced at it, and said: "What is this for?" "Why," said he, "that is for the gas for your house." Said I, "Gas for my house; what do you mean?" He said, "That is for the last three or four months." "Well," said I, "that will do very well. When did you take that indication of the meter?" He said, "I took that yesterday." Said I, "You have taken it for the whole time at one time?" "Yes," said he, "I could not get in before; the door was locked every time I went there." Said I, "I think

it was; I locked that house up myself, and I turned off that meter myself, and I have been to Europe for the last four or five months, and there has not been a light lit in that house during the whole time. So I guess you had better take that bill back to the office, and charge it up to the account of loss and gain." He did so. (Laughter.)

We are running a motor simply for a passenger elevator in one building where there is a bank and offices. It is a four-story building. The man would not take a meter there. He said that he wanted to know definitely just what he was to pay per year, and so we made a contract with him by the year, charging the regular price on the contract basis. I have since then taken some little pains to find out how much they are using that elevator. It is a small passenger elevator, will accommodate four or five persons, but it is very seldom that there are more than three persons in it at any one time. He had a five horse power motor to run that elevator. That motor has not been used, on an average, one hour per day. Still, we are getting the price for a continuous service—$60 per horse power per year. I asked him to let me put that contract on a meter, but he did not want a meter, but wanted a definite amount stated. Now, suppose that you are running that elevator at so much per horse power: The elevator will take three or four amperes, while the Daniels' planer will take 40 amperes, and the elevator is running only one or two hours per day, while the planer is running ten hours per day. You see at once that there is no chance for making the same tariff apply to both classes of business.

MR. LEONARD: Mr. Francisco states that he charges 25 cents per thousand watts; I want to ask him what he means by that. He does not give the element

of time. Does he mean 25 cents per thousand watts per hour, per day, or per week?

Mr. Francisco: A thousand watts is 746 watts in horse power. When a man uses 1,000 watts, he has used a horse power, and a fraction beyond that. When he has used a 1,000 watts, he pays 25 cents; that is our rule.

Mr. Leonard: That is a pretty heavy charge, I think, for power; it is 1¼ cents per hour.

Mr. Francisco: But remember that we are running on steam power, where coal costs us $4.50 per ton. And here is another feature: The entire installation is under our care; we have to do everything that is required. Of course, if a man pays for the installation, he should naturally get the current at a different rate. Where we supply everything and he buys the motor, then we keep it in repair.

Mr. Wilmerding: If we could get at the rate of 25 cents per 1,000 watts, we should prefer to meter, but I have found the meter system unsatisfactory, because the character of the service varies so much. Our charge for elevator service is from five dollars per month to 15 dollars. That is on the basis of 10 cents per 1,000 watt hours. On our contract prices we make three rates: We have a rate for continuous power; a rate for intermittent power, and a rate for elevator service. For the elevator service we charge $5 per month per horse power, or $60 per year. That is for any kind of elevator service. But I have never found that any of those elevators, when run by the meter, shows more than one third of what our contract price would give us. I have also found that our customers are more surprised than we are at the small price that they have to pay for the service. For that reason, I have concluded recently that we will not furnish any elevator service by the meter. (Laughter.)

We do not want to surprise them in that way. That comes to the neighborhood of six cents per horse power.

MR. FRANCISCO: What is the cost of coal?

MR. WILMERDING: Our coal costs $2.65 per ton; but we are using compound condensing engines and our indicated coal consumption is not more than two pounds per horse power hour.

MR. AYER: There has been nothing said here with reference to constant current rates, and it may, perhaps, be of some value to some of us to know what the charges are in that way. We are running an excess of two hundred constant current on arc lights, and we make a charge of $10.50 for a single horse power for 10 hours service, regardless of the character of the service. Where-ever we happen to have a variable load, we indicate the load on those motors as the maximum load, and we insist on their making a contract based on that maximum load. If we find them bringing in additional machines later, our motor inspector is very apt to get track of the fact, and we soon know just what they are doing. We find no difficulty in making satisfactory contracts on that basis. We find that on constant current motors the price has been satisfactory, and we have had no difficulty in making our contracts on motors at $10.50 per month per horse power. For three horse power and upwards, we make the rate $8.50.

MR. WILMERDING: I do not want to be understood as saying that we make a five dollar per month rate straight through, but that is on elevator service. Our lowest contract price for the intermittent service is $6.25, and our lowest price on constant power is $9.00 per month.

MR. T. CARPENTER SMITH: I would say that there is one advantage that a constant current motor has over

a constant potential motor, and that is that a constant potential current will slow down if it is overloaded.

MR. DUNHAM: What Mr. Smith says with regard to the motor, is correct, for I have found in my experience that if a constant current motor is overloaded it will slow down. We run, on an average, from 40 to 50 candle per horse power two and a half miles from the station. The maximum is 56 horse power and it runs down to 38.

MR. SCOTT: I thought this was a discussion of the paper relating to the operation of central stations by water power; and the point that interests me is to know the relative cost of production by water and by steam. As to the charges to customers, though very interesting facts, still, they can be got from the schedules. The charges to customers have been, according to my experience, regulated in accordance with what the customers were willing to pay for the service. (Laughter.) What we central station men want to know, is, how we can produce a good article at the least possible cost. We come together for the purpose of deliberating what are the best methods for us to pursue under different circumstances. From what I have seen in my own section of the country I judge that water power has not superceded steam. The companies there can run on high pressure engines, and furnish 16 candle lamps per hour at an expenditure of half a pound of coal, whereas water will cost them as much as six-tenths the cost of a pound of coal, and when water costs them that much they are not going to discard steam for water. I do not find in this paper a statement of that element of cost. The paper speaks of the rebates costing only one-hundredth of one per cent. The rebates do not cost us that, as we only give rebates to men who kick so outrageously that we cannot get rid of them. (Laughter.) It costs this man

something to keep up his raceway, and it costs him something to repair dams. There are floods. There is no water power that is proof against damage by floods. Then, there is the expense of cleaning out the pond. If those repairs, and the wages of the men who are delegated to make those repairs, cost as much as a load of coal, why should he not buy the coal? I want to get at the facts which will show me whether it will pay us to throw out the coal and take in water. I never take any water in mine when I can help it. (Laughter.)

MR. ARMSTRONG: That is what I want to know, but I do not know whether Mr. Redman has gone into that matter enough to give us the information.

THE PRESIDENT: There is probably no one here, with the exception of Mr. Redman, who has had the means of obtaining accurate information concerning the production of power by water; but I believe Mr. Leonard has had quite an experience in that direction, and if he is in a position to offer us any facts concerning the cost of water power, we shall be glad to hear from him.

MR. LEONARD: I have had some experience in connection with the running of stations by water power, and I think that the remarks of the last speaker are very pertinent and correct, and that the cost of water power, although it is apparently cheaper than steam, is frequently higher than it would have been for a first-class steam plant. I think, further, that water power is not sufficiently constant to entirely eliminate the steam plant. With the exception of a few plants where the water power is peculiarly favorable, the water power has to be assisted by a steam plant, and the ultimate expense is frequently higher than it would have been if they had entirely disregarded the water power, and built the steam plant at the best possible location. In my own experience, I find that the best use to make of water power is

not that of operating a full load, but of taking care of that portion of the load which is quite light and which operates between, I will say, eleven o'clock at night and dawn of the next day; for the load is fairly constant during those hours and the economy of the water power is then more marked, because it enables the services of an engineer to be dispensed with. This use of water power has proved to be very economical in certain places where a not very reliable water power existed, but where, perhaps, 50 or 100 horse power could be obtained at almost any period of the year and which would answer to carry a light load during certain hours of the day and late at night.

MR. T. CARPENTER SMITH: I would say that this question of the relative cost of steam power and water power has been very fully considered in some papers which were read before the American Society of Mechanical Engineers, and, notably, in a paper read last year by Mr. Manning, of the Amoskeag Mills, at Manchester. He states that his experience has led him to the conclusion that, all things considered, steam power will, under almost any conditions, if properly handled, be produced as cheaply as water power. I think that at most central light stations the best use to make of the water power is to use it in condensing. Steam has an enormous advantage over water power, in that with steam you can state almost to a certainty just what your power will cost you. There has been such an enormous experience with steam, and so many statistics have been collected, that the cost per annum per horse power of steam has been determined within very small limits for all the sizes of engines in use. With water power, on the other hand, the contingent expenses are very likely to far more than offset the original cheapness of the water power. If a steam engine has really to be installed as a relay for the

water power, you might as well run with steam all the time, for you have got to keep your engineer there and you have got to keep your fires ready for lighting. And further, a steam engine possesses the ability to be driven beyond its rated capacity, whereas your water wheel is absolutely limited to the power contained in the head, and in case any sudden call is made upon you for increase of power you must either shut down or start your engine; and if you have to keep your engine ready to start up, it is better to keep it going the whole time. I wish to say that I would strongly recommend all members of this Association to secure those papers, which can be had by applying to the Secretary of the Society of Mechanical Engineers. Another paper, which was read some years ago by Mr. Lewis F. Lyne, on the use of headlight oil for keeping boilers clean, is also worthy your attention. I read that paper, and tried that oil, and had such success with it that we have used it ever since. But, of course, the oil must be used intelligently, and I have found the method given by Mr. Lyne to be the best. We have tried it in several different ways, but find that his method is practically the best. These two papers, I think, are well worthy the attention of this Association.

THE PRESIDENT: If Mr. Moore, the representative of the Quebec Company, is here, we would be glad to hear from him. Although he is not a member of our Association, we shall be glad to extend to him the courtesies of the Association. I know that he can give us a very interesting statement in regard to the Quebec water power. I know that he is in the city, but he does not seem to be present.

MR. ARMSTRONG: I move that the further consideration of this paper be postponed, and that when Mr. Moore comes in he be invited to speak upon the subject.

THE PRESIDENT: The next paper is that of Mr. H. Ward Leonard, of New York, upon central stations combining the advantages of both the continuous and alternating current systems.

A CENTRAL STATION COMBINING THE ADVANTAGES OF BOTH THE CONTINUOUS AND ALTERNATING CURRENT SYSTEMS.

We are all well aware of the fact that the greatest strength of the three-wire system is due to features, the lack of which constitutes the greatest weakness of the alternating system, and that the reverse of this statement is equally as true.

The high efficiency, reliability, safety, and adaptability to supply almost any requirements for electric energy, which are the features of strength of the three-wire system, are the very points upon which the alternating system suffers by comparison, for its efficiency is much lower, its reliability is less, due to the fact that its machines are not practically operated in multiple arc; its safety is necessarily less, due to the existence of the high primary pressure, and its current is not adaptable to commercial use for motors, charging storage batteries, electro-deposition, and so forth.

On the other hand, the low first cost of an alternating system, the simplicity of its circuits and of the operation of the central station and its ability to reach, with moderate expenditure of capital, lighting at any practical distance, make it the only possible pioneer in new and untried territory without great risk and almost

the certainty of expending capital which will never be remunerative.

Hence it is that we find the three-wire system in possession of the densely settled centres of cities and towns, and not extending to the outskirts, because of the uncertainty of a sufficient return upon the necessary capital, and both the central station manager and the distant would-be consumers anxiously awaiting the development of improvements which will enable the three-wire central station to supply such distant consumers. And hence it is that the managers and consumers of an alternating system anxiously await the day when motors can be operated and a more economical, safe and reliable current than the present alternating current can be furnished by such a station to supply the imperative wants of the heart of a busy city.

If the above statement of the present existing conditions be a fair one, it will be evident that if we could only in some way secure the advantages of both systems in a common distribution, we should greatly improve matters. The object of this paper is to point out what appears to the writer to be a step forward in that direction.

The following conditions seem to be necessary:

1. We must supply a continuous current for the central portion of a town during the daytime when power is required.

2. We must supply the outlying districts with an alternating current during the night-time when lighting is required.

3. We must not operate the alternating system under conditions of light load when its efficiency is very low.

4. We must be able to supply current for lighting continuously throughout the 24 hours of the day.

5. We must have but one set of conductors in any consumer's place.

In order to meet the above conditions I propose the following:

1. Wire all consumers upon the standard three-wire systems.

2. Connect all consumers upon standard three-wire mains.

3. Arrange the network of mains so that the central section of the network can be disconnected from the outlying sections through the agency of switches.

4. Install three-wire feeders to supply the central portion of the systems at full load, and install 1,000 volt primary wires and alternating current converters with a three-wire secondary circuit to supply the outlying section at full load.

Let us see how we will operate the station. Suppose it is eight o'clock in the evening. The switches which serve to connect the central and outlying sections are open, and our three-wire plant is supplying the full load of the central portion of the city. The alternating plant in the same central station is supplying the converters of the outlying section, which convert from 1,000 volts primary to 220 volts in the secondary, and the secondary coil has a connection at the centre which is led off to supply the central wire of the three-wire system of the outlying section, the outside terminals of the secondary being connected to the outside wires of the three-wire system. It will be noticed that both plants are being operated at full load.

Now, suppose it to be eleven o'clock. The load has gone off rapidly so that the alternating plant is now operating under the worst possible conditions, and these conditions will continue for the outlying district until dusk the next day—that is, for probably 18 hours. An

operator is now sent out who goes to each section supplied by a converter, and by throwing a switch transfers the secondary wiring from the alternating system to the three-wire mains. In this way the small remaining load is gradually transferred to the three-wire plant and then the alternating plant is shut down. The three-wire plant continues in operation all night and all the next day, supplying all devices with a continuous current. Motors can be operated in all portions of the system, even for domestic purposes in the distant residences, and all consumers get the opportunity of the use of the continuous current for any purpose desired for 18 hours out of the 24.

Dusk now arrives and soon the heavy lighting load will rapidly come on, and in such case the outlying section could not be supplied by the small wires feeding the distant three-wire section during the day, which are only about one-tenth the size which would be necessary to supply the full load.

The operator again goes round the circuit and now transfers the load of the outlying section from the three-wire plant to the alternating plant, and this condition prevails again until eleven o'clock arrives, when the operation is repeated, as before described.

The switches for transferring the load of the outlying section from one system to the other can readily be controlled by simple means from the central station itself, if desired.

Now, let us look at some of the advantages we have gained.

All of our inside wiring is done on the three-wire systems for use of a lamp of 110 volts. This means that, for the same distances and loss in conductors, we will save eleven-twelfths of the cost of copper which would be required by a secondary using 55-volt lamps upon a two-wire system; or, to put it in another way, we can

supply 110-volt lamps upon a three-wire system with the same cost of copper and the same percentage of loss in conductors at three and a half times the distance which would be permissable for 55-volt lamps on a two-wire circuit.

We all know the great desirability of using large converters, on account of their cheaper first cost per lamp and their higher efficiency, and also because a far more perfect regulation of pressure can be obtained upon a lot of lamps scattered in different kinds of store throughout a block, if they be supplied from one converter, than can ever be obtained by supplying these lamps by a lot of small converters loaded differently in almost every case, and consequently supplying a different pressure at the secondary terminals of each converter.

Under the system proposed by me one converter would ordinarily supply the entire lighting of a block, resulting in a less first cost, higher efficiency of conversion, longer life of lamps, greater reliability and greater simplicity of plant.

A point worthy of notice is that for 18 hours out of the 24 an absolutely safe pressure is in use throughout the entire system, and that during all daylight hours, when the greatest liability to accident from contact with high pressure wires exists, no high pressure is in use.

With such a system no consumer need be turned away.

The consumer who wants to charge storage batteries, and also make electric welds by electricity, can do so upon the same day and from the same wires that supply his incandescent lamps.

The factory upon the outskirts of town, which runs its isolated plant, and must to-day either use storage batteries or run machinery all night to supply a few watchmen's lights, can now switch on to the central station at

six o'clock, and operate the few lamps it may need until dusk next day, when heretofore the alternating system, which was the only one that could reach it, did not run after midnight, or possibly after daybreak, because of the loss of money in so doing.

With this system the outlying districts can be pioneered with the least first cost and least risk. Any outlying section in which, for any cause, the demand increases greatly beyond that originally anticipated, can be supplied permanently by the three-wire system by merely running the necessary feeders to supply the already existing mains, and in such case the switches and converters would be moved out further or transferred to some new section ready for pioneer work.

The combination of a storage battery system and an alternating system also presents peculiar advantages. The storage battery is at its best when supplying a small steady load, such as we have for at least 16 hours out of the 24. The alternating is at its best when supplying the full load possible only during the remaining eight hours. The average electrical load on a general system is only about 12 per cent. of the maximum, consequently we are entirely safe in the statement that the greatest load during the 16 hours of light load is not more than 10 per cent. of the maximum load for the 24 hours.

If we were to attempt to operate the heavy load by storage batteries, we must either make an enormous investment, or, what is even worse, operate storage batteries at a disastrous overload. On the other hand, if we try to operate the 16 hours light load with converters, our efficiency, when operating at 10 per cent. of our converter capacity, would be unmentionably low. But reverse the case and everything works at its maximum efficiency. During the eight hours of possible heavy load, we operate all devices by the alternating system.

At the same time a continuous current dynamo charges our storage batteries located either in the central station, or, if more desirable, at different centres in the system of distribution. At the end of the eight hours' run we shut down the plant, lock up the station, and leave it for 16 hours, the storage batteries meantime supplying all devices.

If, for extraordinary reasons, we have not capacity sufficient in the storage batteries to supply the demand, we run the continuous current plant to assist it; and if that should fail or prove insufficient, we start up our alternating and supply all or a disconnected part of the system with it.

With this plant distances are of no consequence; we can use 1,000 volts for the continuous current plant as well as for the alternating, and the single two-wire distribution is all that is necessary for perfect results.

The weak spots of this latter arrangement will, no doubt, be thought to be the storage battery, but my experience with this device is that if you use it properly under suitable conditions, and do not attempt to squeeze impossible results out of it, economical and satisfactory service can be obtained from it, and certainly no better conditions could be obtained for it than those described above.

Up to this time a bitter fight has waged between those believing that the alternating, the direct, or the storage battery system, respectively, was the only suitable one.

I believe in them all, each operated so as to be used under the best conditions for its use, and I trust that the suggestions given above may lead to our being better able to meet and overcome our common enemies: High first cost, low efficiency, danger, unreliability and the inflexible conditions of the existing demand.

DISCUSSION.

MR. T. CARPENTER SMITH: I am afraid that in rising to speak upon this paper, my audience will understand pretty well what ground I am going to take. I wish to begin by remarking that history has told us, and has repeated its story over and over again, that no State, no municipality, no corporation, nor any individual, can afford to defy public opinion. It may seem to do so successfully for a while, but it must ultimately be crushed by public opinion, which, if it be leaden-footed, is also iron-handed. I think if there is one feature in our business which has been overlooked, it is the relation with which we are most concerned, and that is the relation which it bears to the public. We have been accustomed to speak of the efficiency, the reliability, the safety, the easy adaptability of any of the various systems in use, only with reference to the relation that those features bear to the central station itself. The consequence has been that all currents using high tension, have almost without exception, in the first years of the business, been installed in such a manner as to be a serious menace to life and property, and, therefore, have been universally condemned by the uninitiated public. I wish, therefore, to say that whatever remarks I may make are based upon the relation of electric lighting to the public, and not upon its relation to the central station.

With that statement as a starting point, I wish to join issue at once with Mr. Leonard in his statement that the alternating system suffers by comparison with the three-wire system, "for its efficiency is much lower; its reliability is less, due to the fact that its machines are not practically operated in multiple arc; its safety is necessarily less, due to the existence of high primary pressure, and its current is not adaptable to commercial use for

motors, charging storage batteries, electro-deposition, and so forth." I will start out at once with the first of these —as to its efficiency being much lower—and will say that for efficiency from the standpoint of electrical engineering, the average efficiency during the twenty-four hours of the converter system, as at present installed, may be lower than that of the three-wire system; but with regard to the satisfaction of the public, I think that the efficiency of the alternating system is considerably higher. I have been operating now for nearly four years the alternating system, and we supply 3,000 lights in a district of the area of six city squares; we cannot go any farther, because we cannot get a franchise. Our district is honeycombed by the three-wire system. Their central station is within a block of us. Their wires run down every block on which ours are found, and on some blocks where ours are not. They have connections in nearly every building in that district, and yet they have never succeeded in taking a single light from us. On the contrary, we have taken several customers from them, simply on the ground that their customers could not stand the poor regulation. The sudden changes in the light annoyed customers so much that they preferred to come to us. We have never lost a customer from bad service. We have thrown several off, but we have never lost one. Mr. Leonard says that "its reliability is less, due to the fact that its machines are not practically operated in multiple arc." I do not think that amounts to anything, and for this reason; that while the machines are not generally operated in multiple arc, still they can be and, if there were any necessity for it, they would be so operated. I do not think there is any necessity for it and I prefer not to do it, because I think that in case of accident to any one machine there is far less danger of accident to others. Any one

machine being broken down does not give you the risk of breaking down other machines running on the same circuit. The time required to throw in the switch of a relay machine is not more than the time which is required to throw in the switches which Mr. Leonard uses for transferring from one system to the other. In actual practice that simply amounts to the winking of the lights for one instant. Another advantage, and one in which safety is also concerned, lies in the fact that the alternating system has its load divided up into small units. That is to say, no matter hôw badly the wiring may have been done in any one building, it does not effect any other building, and one customer cannot threaten the safety of every other customer of that station by having his apparatus or the wiring in bad condition. The failure of one group does not affect any of the others. The alternating current in itself, from the mere fact of its being an alternating current, has an immense added safety in the fact that it will not strike an arc. It is difficult to foul an arc with it, except under very high pressure. We have had that illustrated, over and over again, in lamps under conditions where a 50 volt direct current would cause the blowing of the fuse.

A very serious question, which was brought before the Committee on Safe Wiring, is one that we must face before very long, and must consider seriously, and that is the grounding of the neutral wire. There have been several arguments brought forward as to why this should be allowed. It practically came down to this, that the insurance agents and inspectors have preferred to ground the neutral wire, and practically make a return to the one wire system of installing electric lights, to avoid the much greater danger of the 220 volt arc between outside wires, and the consequent damage in buildings where combination fixtures are used. Now, I do not know

whether it is a good thing to go back to the one-wire system of wiring; that is an engineering question that we shall have to determine by years of experience. But I do know that if the grounding of the neutral wire is permitted you must also permit the grounding of the transformer. You cannot make fish of one and flesh of the other. And, more than that, I do not believe that is the real reason of the desire for the grounding of the neutral wire, but that it is rather due to the fact that any failure of the third wire would cause the blowing out of the lamps on one side or the other, according as the load may be placed. That objection would equally apply to Mr. Leonard's plan of wiring up all the lights on the three-wire system. I think that the inherent defects of the three-wire system are enough to forbid its use. The two-wire system will meet those conditions. You can do your wiring on that system, if you please, on 100 volts; although I think myself that the lower the voltage we get, and the larger the conductors we get, the better safety we get, and the slightly additional cost in installation is generally borne by the consumer.

The statement that with large converters we get cheaper first cost, higher efficiency, and better regulation of pressure, I fully agree with. I will speak of that later on, when I come to point out the method of alternate distribution which I think meets all the points that Mr. Leonard desires.

The statement that the alternating current is necessarily less, due to the existence of the high primary pressure, I beg to deny. The three-wire system in use gives an absolutely continuous metallic contact from dynamo to lamp, from street main to lamp, and from every lamp on a circuit to every other lamp on that circuit. These three-wire systems, finding that they could not operate their street circuits with any economy, have installed

high tension machines, carrying considerably higher voltage in many cases than the ordinary alternating system. It is very evident that the first contact between that high pressure wire and the street main at any point, however slight it may be, puts that high tension on every lamp on that circuit. To do that with the alternating system, you have to break down the insulation of every converter. Personally, I have never known of a case of contact between the primary and secondary coils of a converter. I know that such have occurred, but I do not think that there has ever been one worth considering, when we think of the enormous number of converters that have been put into service, the immense strides that have been made by the alternating system, and the small knowledge we had of it when we first started to install it. Those are accidents which will teach us lessons, but which should not lead to a condemnation of the new system. The high primary pressure we must have, no matter whether we use the continuous or the alternating current. We cannot carry the current without it. It is exactly the same as with water pressure, or with steam pressure. Twenty years ago fifty pounds was considered high steam pressure; to-day, eighty pounds is the average. I do not think that of the new boilers that are being installed less than twenty-five per cent. are being put in for a pressure of less than 150 pounds; and in ten years 150 pounds of steam pressure will be used where 80 are now used, and 200 pounds where 150 are now used. We know that in all new stations that are being installed, in all new plants where steam is being used for power, the constant tendency is to raise the pressure. It is kept safe simply by the addition of proper precautions due to the increased pressure.

The statement as to its current not being adaptable to commercial use for motors, thus far would seem to be

proved; but four years ago that same argument was brought forward, that the current could never be used for motors. I think that the alternating current motor has pretty well fought out its own case, and worked out its own salvation. I do not think that there is to-day any direct current motor on lines on which they are in use, that can compare with the motors that have been brought forward as the direct result of the alternating system. I, therefore, think that in a few years we shall see this motor in the same way. We do have a demand, however, for power and, thus far, we must admit that the alternating motor, except in small sizes, is not well adapted for use in certain central stations, although it is of great use in isolated installation. I think, however, the experience of every central station is that it is better to have separate circuits for power and for light. And I think that this plan will meet fully all the requirements of the central station, and that you can use the alternating current for your wiring, and the continuous high tension, constant potential current for your motors; that constant potential current can also be used for charging storage batteries, and for any of the other purposes for which the direct current is used.

The safety to the consumer by the use of converters is not only limited to the accidents from the system itself, but it also has its value in the case of light installments. Not long ago, there was a discussion between the advocates of the direct and the alternating currents, at which one of the advocates of the direct current called attention to the fact, and gave it as a warning against adopting it, that the converter was simply a good lightning arrester, to protect one company at the expense of the other; and one alternating current advocate present had the good sense to rise at once, and thank him for the advertisement. I do not think that there is any

stronger argument that you could use for its adoption. The people who are operating stations presumably know what they are about; they know that they are handling a dangerous element, and they will take care of it. Their employees should be well instructed, and then if an employee is injured, it must be due either to his own carelessness, or to those accidents which, to a certain percentage, must always happen.

I think that when you sum up the disadvantages of the alternating system you will bring them practically down to one, and that is poor efficiency on low loads. To meet that, a system must be devised which will have all the advantages of the alternating system, and which will have an efficiency practically the same at low load as at high load. At high load, I think the efficiency of the transformer system is as nearly perfect as we are likely to get it. The further improvements will come in by the use of better material, and of greater care in manufacturing. With these improvements, I think, it will pretty nearly reach the theoretical advantages. The 1,000 volt primary current which is in ordinary use is not high enough for large cities. Ferranti uses 10,000 volts, and has been operating under that current for several months, and with apparently great success. I think there is no doubt that the time must come when we will use higher pressure than 1,000 volts at central stations, and then get right out in the outskirts where we can have cheap fuel or water power, and from there send into the city under high pressure the whole current, taking off nothing on the way; that we will have sub-stations where the current will be reduced from very high pressure, which must not be handled at all, to a lower pressure midway between the generating pressure and the distributing pressure, and with that we can supply the districts. In the substation it will then be possible to install three or four

large converters, or any number that may be required, connecting them up in the multiple arc; and then when the load gets light, instead of changing over to another system, we will simply cut out some of those converters on both ends, leaving only fully loaded converters to carry the load. This, of course, is open to the objection that it requires the presence of an attendant, but devices have been made, and are in operation in England, whereby that change is made from the central station by means of automatic switches which can throw in one, two, three, four or five of those large sub-converters. I do not believe in the use of small converters; I think the larger you can keep your converters the better; yet we have to weigh very carefully the disadvantage of having too few lights in one converter and too many lights in one group where by the grounding of one part of the group you may affect the safety of another part. It is between those two limits that we must fix upon our most efficient size of converters.

The same rule holds in figuring up the size of conductors. In figuring up the size of blast pipes used in our large rolling mills, and the size of water mains, that question is continually coming up; and the limits on one side are the interest on the extra money expended in the first place, and the loss by friction, or by resistance, or by pressure, or whatever it may be.

The use of the two systems in this way, by keeping all the customers continually wired up upon an alternating system, avoids great danger of connection between your high tension wires and your low tension main. If your high tension wires get crossed with your high tension direct wires for the supply of power, the station may be hurt, but the consumer is not likely to be. Say what you will, it comes down to this, that it is the consumer who will regulate the running of your station. If

he does not regulate it by legislation, he will do it by hurting your business, by refusing to take what you supply under arbitrary conditions. And so we come back to the proposition with which we started, that no corporation, individual or government can say, "The public be damned," and not suffer for it. (Applause.)

MR. LEONARD: Mr. Smith seems to have made the error of assuming that I am appearing in the role of an advocate of the three-wire system. If such an impression exists, I want to correct it as promptly as possible. My remarks with reference to the three-wire system and the alternating, were such as would be admitted by almost every one to-day. I presume that any one familiar with the facts would admit that the average efficiency of the three-wire system was higher, that it was conspicuously higher at loads; and in speaking of the possibilities and advantages of the system which I have proposed, I was only giving consideration to the existing conditions of to-day.

First, I will speak upon the points that Mr. Smith has mentioned, as I have noted them. He spoke of the disadvantages of operating the multiple arc. And yet, it seemed as though the universal opinion must be that a multiple arc arrangement of dynamos is preferable to a separate one, when we remember that in the first part of the business of electric lighting, machines of constant potential were operated on separate circuits, and that they have been gradually placed in multiple arc is due to the advantages gained thereby. I think you will almost never find to-day an isolated plant where we have a large number of machines supplying a constant potential distribution, in which each machine is supplying a separate circuit. The possibilities of regulating, and the economies, are so much higher when machines are in multiple arc, that, entirely outside of any consideration of central

station supply, or of the three-wire system, it seems as though the result of experience has been that where machines can be operated perfectly, simply and reliably, with multiple arc, it is better to do so.

With reference to the question of grounding the neutral wire, I can dismiss that, by stating that I agree thoroughly with Mr. Smith that the grounding of the neutral wire is extremely bad practice, and that there is no argument for grounding the neutral, except, perhaps, that of laziness.

As to high pressure primaries, the paper which I have read, of course, bears evidence in itself that I am a thorough believer in the necessity of high pressure primaries for reaching any great distance, but there certainly appears to be an advantage in having those high pressure wires as few in number as possible. And, instead of having a complete network through the city of high pressure wires, if we can by any means restrict a few of the high pressure wires to centres, there will be less liability to any trouble due to the existence of high pressures.

Mr. Smith has mentioned that, in his belief, an alternate current motor will soon be attained in practice, and ready for service. I thoroughly agree with Mr. Smith on this point, and have no doubt that an alternate current motor will soon be ready for commercial service, but how soon, is a question. In the meantime, the existing condition to-day is that the central station manager cannot secure an alternating current motor to put upon existing circuits and, in fact, the work that is being done on an alternating current motor thus far is not of a kind to indicate that an alternating motor which can be placed upon the same circuit as an incandescent lamp will result.

One point I will state, before going further: All of

my remarks have been on the basis of the three-wire systems, merely because of the saving in the cost of conductors which is attained thereby. Were we able to have a 200 volt lamp, instead of 100 volts, it would be, of course, infinitely preferable to have the two-wire system, and use a 200 volt lamp, than to have three wires for a lamp 110 volts on each side; and, furthermore, the cost would be reduced even beyond that of the three-wire system. As to the sub-station method of operating upon the outskirts of towns, that is, unquestionably, when the alternating current motor is at hand, a very desirable way of operating. And yet it seems to me that even there, until we have our 200 volt lamp, it will be extremely advantageous to use for distribution something that will enable us to reduce the cost of our conductors on the consumer's premises to a point far below that of 50 volt lamps. As I have pointed out in the paper, at the same distance, and at the same percentage of loss in conductors, the cost of a three-wire system will be but one-twelfth of that of a two-wire system with 50 volt lamps, and if we had 200 volt lamps with the two-wire system and our secondary distribution, it would be but one-sixteenth. Consequently, when we deliver our high pressure to the sub-stations, and are ready to distribute to our consumers, we should have to have a very large number of sub-stations in order to operate 50 volt lamps, or else we must have an enormous expenditure in conductors. It seems to me that under the existing conditions it will be well, and, indeed, the best way that we have at present at command, to use the three-wire system, as it does enable us to distribute from that centre, and at low pressure, and at the least cost. When the time comes that the 220 volt lamp is commercial, the three-wire system will, of course, still present the advantage of being able to reduce the cost, but the high pressure that will

be realized then may be a sufficient argument against the use of 500 volts in the premises of the consumer, and may make 200 volts satisfactory.

Mr. Smith: I wish to speak first in reply, because I wish to straighten out a little matter between Mr. Leonard and myself which might interfere with the proper carrying on of the discussion afterward. I fully understand Mr. Leonard's attitude in this matter. My remarks about the three-wire system were not made with any idea that Mr. Leonard is upholding it as against the alternating, but because he, in his new plan, calls for all inside wiring to be done on the three-wire system for lamps of 110 volts. I, apparently, did not make it clear that the 200 volt direct current in the building is what the insurance people are afraid of now, and that, consequently, we must abandon that in any new system which is to be an improvement upon it. The use of an alternating current of 220 volts, I do not believe would have that disadvantage, and in that case Mr. Leonard's plan would be all right. But as his plan contemplates using, during a part of the time, a continuous current of 220 volts, I feel that the 220 volts should be barred altogether. Of course, on 55 volt lamps, we can use the three-wire system, and, in many cases, where buildings have been already wired, we may get a proportion of reduction of copper in that way. With regard to the multiple arc, I would say that, in my experience, the multiple arc in isolated work has been used to save the running of new feeders. Where a plant has been wired up throughout, and one dynamo installed, and then enough lights put on to take up the whole capacity of that machine, and the customer wants more light, he taps the wires which he has. But when he goes to put on new power, he simply couples his new dynamo into the bus-bar, just as a man who puts in a new boiler in a steam plant couples in the

old steam pipe. If the old steam pipes were too small, he would run a new main. And so it is with an electric light plant. Where we install an isolated plant, we always put it so that three or four dynamos can operate, though, as a general rule, they are all in multiple arc. Another reason for operating a multiple arc is found in the fact that small bus-bars have been hitherto made in machines. A thousand light dynamo is about just so far good for practical use, but we have 3,000 light dynamos for the alternating current, and larger ones are to be built and used. In that case, I do not think there can be any question about multiple arcing.

With regard to sub-stations, I would say that Mr. Leonard seems to have slightly misunderstood my point. The sub-stations are not for the purpose of direct supply to the consumer; they are for supplying the sub-mains, which are run at much higher pressure than we would introduce to the customer, and the customer is supplied through a second series. That, of course, gives us the double conversion, and the loss caused by double conversion as against the loss caused by single conversion, but it gives us the advantage of running one of those converters always at its greatest efficiency; namely, a full load.

The whole question, of course, as I have said, comes back to one of interest on first cost, as against loss in feeders. So that, in speaking of sub-stations, I do not mean to be understood as saying that there would be an enormous number of sub-stations, but only one for each district—very much the same way as Mr. Ferranti is operating in London. We have been looking very anxiously for the completion of that station. He is a very young man, and has taken hold of the problem in a way calculated to alarm a great many older heads; but his own personal energy, and his constant overlooking of every detail, is such that I think we cannot give enough praise

for the success that he has made at his station. He is handling there pressures that we never dreamed of ten years ago. I well remember when on the floor of this convention 10,000 volts were spoken of as being carried through the country on a line of poles which should have a dead line 100 feet each side, and which, if any tramp crossed, it would be a good thing if he were killed. And yet Ferranti is carrying such a line through the streets of a crowded city and nobody knows anything about it; and, as a rule, the less the public do know about such things the better.

MR. LEONARD: I think that Mr. Smith has made a very ingenious argument upon the multiple arc question, but I hardly feel that his position is sustained by the facts or by practice. Of course, as he has pointed out, where conductors are placed on one dynamo, and the load gradually increased, they are driven to the multiple arc arrangement, unless they are going to put in new conductors. The fact is that every large isolated plant that I have ever had occasion to bid on has been so specified and rated by the common consent of all companies that have entered bids, that the dynamos shall be in multiple arc, when there were eight or ten at the beginning; and it is the universal practice in all companies so to design their plants; and, hence, the multiple arc arrangement is one that has been forced by the unexpected enlargement of the plant rather than by a deliberate design, to obtain the best results in the beginning. Mr. Smith has spoken of an arrangement of sub-stations, but he has not yet pointed out how he gets rid of the losses that will occur upon the final converters. He has put in an intermediate set of converters, and has taken means to take out converters as the load diminishes; but his final converters, in his distribution throughout the city, are still connected, and are the same as we have had before.

MR. SMITH : I would use the same plan that Mr. Leonard proposes in his system ; I would have them grouped and switched in and out by the operator just as I do in the sub-stations. I am only comparing one system as against the other. With regard to the multiple arc, I will say that I still hold to my proposition that multiple arcing is not put in because it is a great advantage, but it is put in to allow of two machines being connected together. It is a good thing, simply because in an isolated plant the conditions are different from that they are in a central station. Your loads are all one side of the bus-bar, and you are required to run two dynamos cut apart, and it is similar to running them together in the same building. If you take an ordinary building, where, as a rule, two machines are put in for use against the chances of break-down, the machines have to run in multiple arc, because the wires are fed from the same feeder. Our alternating station is run in practically the same way, only, instead of switching the dynamo out of the multiple arc, we switch a feeder into the multiple arc on another dynamo. Our dynamos are united inside of our circuit. In the one case the dynamo is multiple. In the central station, we simply shut down the dynamo, and we transfer the feeder load. I cannot see that running the station in multiple arc is any particular advantage, or that running an isolated plant in multiple arc bears upon the question directly. It is an advantage to run a multiple arc, but in central station work the advantage is not so great as in isolated plants.

MR. LEONARD : I have one further remark to make and it is this : Mr. Smith explained how he was going to reduce the loss of the final converters of the circuit by throwing off a part of the load when the load became too heavy. This necessarily assumes an arrangement of converters in multiple arc on the secondary, which is not

contemplated in my scheme, and is not in practice to-day.

MR. BELL : At the risk of stirring up all parties in this discussion, I want to make one or two suggestions with regard to this scheme, and the first of them is to suggest the question as to whether or not a 220 volt alternating current is a pleasant thing to have around the house. I have very grave doubts about that. I am not afraid of the direct current, or of 220 volts straight current, but when it comes to turning loose 220 volts on the three-wire system, alternating around and about the house, it seems to me that it is a good thing to avoid. I know that there are plenty of alternating current men who say that they have no fear of a current of 1,000 volts ; but, in all seriousness, I think that 220 volts alternating current is a thing that has got to be handled rather delicately, if buildings are to be customarily wired for it. I do not know that there would be any risk to life from 220 volts alternating current, but, at the same time, I think the public would view the matter with a little doubt.

As to the question of alternating currents, I think that we ought to remember that on the other side of the water alternating currents are habitually run for the purpose of keeping the whole system loaded to its fullest capacity. We do not happen to do it here, but they do make a practice of it over there, and with great success. As to the reason for it, I think it is all summed up in the saying that it is a good thing not to put too many eggs in one basket. If you have a 100 kilowatt machine, and anything happens to it, the whole station is down right then and there until that machine is fixed If you have three or four smaller machines, you may be able to crowd on a load, and thus keep going. But I have heard grave doubts suggested, by those who know

Ferranti personally, as to whether he will ever complete those machines. There is such a thing as getting an alternating current so big that you cannot handle it efficiently, and I think that those units of Ferranti's come very near that.

MR. SMITH: I have brought a good deal of unpleasant newspaper comment upon myself by certain statements that I have made in public, but I have made those statements, and I am prepared to stand by them, and every experience that I have had since making them has only confirmed my belief. For the whole public I cannot speak, but for a certain small section I can speak. We did have—but I have changed them all, for other reasons—several buildings in which we had 220 volts of alternating current. The buildings had been originally wired for the three-wire system, but with very small wire. We had to make the change rapidly, and could not take time to increase the size of the wire. We took four 50 volt converters, and coupled the primaries in multiple arc, put secondaries in each system, and put them across the three-wire system. We found that our customers did not object half as much to the 220 volt shock of the alternating current as they did to the 220 volt direct. The shock is, undoubtedly, a great deal more unpleasant, and, for that reason, I think, is rather a good thing, for it discourages the multiple current which the customer is only too prone to indulge in. The real danger to life, I think, must not only be taken into consideration in that shock, but the far greater danger from fire. We have no hesitation in saying—and we do not think there is any insurance man here present who will not agree with the statement—that the danger of fire from an alternating current of 220 volts is not ten, but 100, times less than from 220 volts of the direct.

Another thing: Our three-wire stations have developed in practice (although I doubt if any of them would admit it in public) a very easy, but very reprehensible, practice of burning out their grounds at night. When they discover a ground upon the system, they find it easier and cheaper just to slip in three or four big machines, and let her go, and they will find out where the ground was next morning. That is pretty bad, as regards the danger to life, and, I think, very much greater than any chance of any accident arising from a 220 volt shock. I am not contending for 220 volts of alternating current; I do not like it myself. I am only pointing out the fact that, as compared, one with the other, if 220 volts of direct has not been found dangerous or objectionable, the 220 volts of alternating will not be found so.

Mr. Orford: For three years, in Bridgeport, we have been running the three-wire system, and we have had 3,000 lights in operation. The question of danger, that Mr. Smith speaks about, we know nothing of. We have never had any trouble whatever in that way. We have had a few fuses blown, as every person has had, but as for fires, we have never had any. We are able to distribute the current from the dynamos a distance of three-quarters of a mile, giving us a pretty large district in which to distribute the current. But we found that we had some outlying districts that we were not able to reach, and then we began to inquire into the question of putting in an alternating plant. The only way I could make inquiries was to go around to central stations, and try to find out what they were doing. I would go to the manager of the central stations in the several towns, and, when I talked with him, so long as he thought I was a stranger to the business, he would represent the matter as being eminently successful in every respect;

but when I came to asking him a few leading questions he would sometimes turn and ask me why I asked the questions, and who I was. One question I put was this: "Have you been able to displace gas altogether?" The answer was, "No, certainly not." "Do you advise your customers to take their gas fixtures out?" "No; what would we do that for? What would we do if anything happened to our lights?" I found that that information was sufficient for me. I found that the alternating system, with them, was not even an alternating one, but that you had to alternate it with gas. There was one gentleman of whom I asked the question, who had had experience with both the direct and alternating systems. He said that the only thing he could say for the alternating system was that it was very destructive. It certainly had no advantage, that he could state, over the direct system, except that you could go further with it; but when you attempt to go further with it, you have to put in just about as much wire as you would under the other system.

Then you have, on the other hand, a continuous watch to keep upon your customers. With our 650 light machine, that was the point that I carefully watched, but as our maximum increased, say up to twelve o'clock, we would have a ratio of one-third increase right straight along. Even if those converters had no lights on them they would still run one-third at a loss. Of course, we inquired into the cause of this from the parties who had sold us the apparatus, and, incidentally, one of them admitted that it was due to the converter; but he thought better of that afterwards, and he had some one sent down to explain that this slowing up after twelve o'clock, although it indicated amperes, took no power. I rather doubted the assertion, and so I made the test, and found out that it did take power. We are so satisfied with the

continuous current in Bridgeport that it has been adopted in New Haven, and in some other places. They have an alternating system in New Haven, also, but it furnishes occasion for many complaints. It may be that the complaints are due to the fact that they are not able to operate it.

I think that in Philadelphia, where Mr. Smith is able to give better service than the man with the continuous current machine, his competitors must have a very poor manager. I think that I could wake them up a little bit. I do not think that you would see any variation in our lights at eight o'clock in the morning. We put our machines in, and they go from 100 amperes on each side up to 1,000, and I defy any one to tell when we put a machine in, or when we take it out. We are running what may be called a bastard machine. Of course, we are not under the Edison patent. We were forced to steal our devices, or else contrive them for ourselves. As for such things as regulators, as you call them, we have none of them. It would be impossible, with them, to keep our lights at equal pressure all over the system, but we have a method of our own by which we are able to do it, and so satisfactorily that our customers are not putting in any gas pipes. We have dry-goods stores where they are paying out from $2,000 to $3,000 per year for lights, and they have no gas in the buildings. Their meters are gone, and the gas fixtures have been taken out. We have not paid in the shape of rebates five cents in five years; and we have had no customers say to us that our lights were out for five minutes.

As to the cost of running, we are not able to tell anything about it, except that when our customer puts out his lights, we do not lose any more power; and when he puts out his lights on the alternating current there is just as much loss on the machine as there was

before he put them out. That may be a little exaggerated, but it is in that direction.

Now, with regard to the fuses, we took the fuses out of the secondary altogether, and we took them out of the primary also, so far as they related to the converters, and we adopted the plan of having a switch, and in the switch-box there is a fuse which is connected directly from the main. So, if we have occasion to do anything with the converter we can disconnect the circuit from it entirely. We have had no trouble with converters. We have had quite a number of them in operation for over a year, but have had no trouble with them. I am surprised that we have had so little trouble. We took the precaution of grounding our circuit at the terminals, and at various points in the centre.

There is one thing that I have found out about the alternating system, and that is, that it is not able to take care of itself; it generally wants someone to look after it. We had a man cut down a tree and the tree fell across our mains, and brought two wires together. The wires fell to the ground, but our customers knew nothing about it. The other day we had two wires come together in one of our branches of primaries. It was a stormy evening, and it crippled the whole service on that branch. We had a fuse in and, fortunately, the machine was able to blow the fuse. But an alternating machine is not able to rise to such necessities as that.

I will also say that my idea of fuses has never altogether met the approbation of the insurance people. I do not quite believe in copper wire, because it takes a high heat to melt it, and I do not believe in putting in a small fuse. I do not like a single fuse put in below ten amperes. Ten amperes is not a very large amount of current. We never use less than No. 18 wire. We have had no trouble whatever in that direction.

I would say, in conclusion, that, so far as we have gone, we see the necessity of both the continuous and the alternating current, and we do not think that any station is complete without both.

MR. SMITH: Replying to the last speaker, I would say that this is simply an individual case, where, by first-class management, he has got a first-class station, and I would say in his case, as I said in the case where I was asked to select a manager for an alternating station, that I would not ask for any better man to run an alternating station, because he has shown that he can run a central station, no matter what it is, whether direct or alternating.

With regard to the people telling him that they have not advised their customers to take out gas, I would ask him if direct companies do, as a rule, advise their customers to take out the gas? On our station of 3,000 lights, we have seven newspapers and four of those papers have not had gas used in their building for about four years. One of our customers is the Franklin Institute in Philadelphia, which has its drawing school and library open every night. The day we put the light in they took out all their gas fixtures and they have not had them in since. We installed an isolated plant, that was put in on the central station plant in Philadelphia two years ago, of 250 lights, in the Spreckels' sugar refinery. Before that time Mr. Spreckels had been using the direct current system. His refinery has been running night and day since the 19th of September, two years ago, and in that time he has never lost a light, nor has his plant cost him one penny to run, as he has told me more than once. We advised that no gas pipe be put in, and there has not been a foot of pipe put in that building. I may mention that estimates for piping that building with gas were $1,500 more than his entire elec-

tric plant cost him, including boilers, engines, wire, dynamo, and everything complete.

The question whether your light will be reliable or not has a great deal more to do with the way in which it is run than the system used, and I think that is a point which is not nearly enough considered. For every station using alternating currents which has put in direct current apparatus afterwards, I think we can show a dozen that first had the direct, and put in the alternating afterwards. The two systems have their uses undoubtedly. The point I wish to make is that I believe, for lighting purposes, you can do just as much with the alternating system, when you have spent one-half the time and one-half the money on it, as has been spent in bringing the direct current system to its present perfection.

(Several members expressed a wish to hear from Captain Brophy.)

Captain Brophy: Mr. Chairman: I think all of you will understand the delicacy of my position. I am dealing with people who use both systems. I do not wish, under any circumstances, to take sides in that discussion. I do not think it would be proper for me to do so. Perhaps I have had as much experience in watching the good and bad points, or seeing the good and bad points, of both systems as any one, owing to the position I have held. It would be very unfair for me to give to the public the weak spots in any one system, if I knew them. They both have their good qualities.

I only wish to say one thing in regard to the matter of fuses. I have studiously insisted upon increasing the size of the fuse. The system of using a certain sized fuse for a given number of lamps has caused a great deal of trouble and annoyance. As a rule, in the central stations the fuses are altogether too small. They should

never be below the safe carrying capacity of the wire, and in 95 cases out of 100 they are; except, perhaps, in our own territory, where I have insisted upon their being increased. Now, I am very glad to have listened to the discussion between the two gentlemen. I believe you are all intelligent enough to draw your own conclusions, and that you will shape your action according to circumstances. I am one who does not wish to alarm the public. I am one who has met, on every occasion when it was possible, the alarmists, and combated them. I believe that if we use high potential or dangerous currents, we should let the people know that they are so. We should not introduce into their houses, for their families to use and handle, anything that we consider dangerous, and not let them know.

As to the matter of fire, I wish to say here that the losses from fire by the introduction of the electric light system have been too insignificant to take any notice of. It is true that it is said that one of the largest fires in Boston for years was caused by the electric light. There are certain officials all through the country to-day—some of whom are more ornamental than useful—whose duty it sometimes is to determine the cause of a fire, and they very often know very little about it. In years gone by, the standard cause of a fire, when no other cause could be assigned, was spontaneous combustion, or matches gnawed by rats; now it is electric light wires.

I trust that all you gentlemen will see that you install your wires as carefully in the future as you have done in the past, and improve upon them. (Applause.)

THE PRESIDENT: The next paper on the programme is by Mr. Burleigh, of Camden, New Jersey, upon uniformity of method in keeping central station accounts.

UNIFORMITY IN METHOD OF KEEPING CENTRAL STATION ACCOUNTS.

The National Electric Light Association partially fills its mission by bringing together, twice a year, central station managers and others interested in the production of light and power; but notwithstanding the very valuable paper of Mr. A. R. Foote, read at the Niagara Falls meeting, and the papers of Messrs. Smith and De Camp, read at the Kansas City meeting, absolutely nothing has been accomplished towards a uniform system of accounts or a classification of expenses.

All, I am sure, feel the great necessity for a more comprehensive and uniform system of accounts; a system that will show the exact cost per unit of their output; a system that, being kept uniformly by all, will give managers an opportunity of comparison with each other.

This knowledge of cost per unit of output is particularly felt at this time, since nearly all central stations are in direct and active competition with other illuminating companies and with other means of supplying power.

At present no two keep their accounts alike; hence comparison with each other is out of the question.

The principal function of accounting is to bring out the fact that the average cost of certain items of expense per unit of output in one station exceeds the average

cost per unit of the same items of expense in another station, and the accuracy of these averages depends entirely on the uniformity of accounting. Great differences in these averages would prompt an inquiry as to the cause, and if the circumstances did not warrant higher averages, steps could be taken to reduce the cost of these particular items.

To make these comparisons of any value to those desiring to make use of them, a uniform classification of accounts should be adopted; and to insure accuracy, the different items of expense, chargeable to the different accounts, should be specified.

The operating accounts proper embrace the current working expenses and the cost of keeping in good order the original plant.

The company with which I am connected have classified their accounts as follows:

CHARGEABLE TO	Arc Lighting.	Incandescent Lighting.	POWER.		TOTAL.
			Street Cars.	Stationary.	
Boilers, repairs of					
Belting, "					
Boiler House and Stack, repairs of					
Carbons					
Clerks					
Converters, repairs of					
Dynamos "					
Dynamo Attendants					
Enginemen and Firemen					
Engines, repairs of					
Fuel					
General Officers' Salaries					
Horses, Wagons and Harness					
Insurance					
Interest on Notes, Bonds and Mortgages					
Incidentals					
Instruments of all kinds					
Lamps, repairs of					
Lamp Supports and Fixtures					
Lamp Globes					
Lamps, Incandescent					
Linemen					
Labor at Stations					
Labor on Street Cars					
Loss and Damage					
Legal Expenses					
Meters, repairs of					
Motors "					
Oil					
Office Expenses, repairs and furniture for					
Poles & Lines, maintenance & renewals of					
Right of way					
Station, repairs of					
Stationery and Printing					
Superintendent and Foremen					
Steam Piping, repairs of					
Shafting, "					
Taxes, City					
Taxes, State					
Tools, repairs and renewals					
Trimmers and Inspectors					
Water					
Waste					

All expenses that are naturally or entirely charged to either arc lighting, incandescent lighting or power, are entered in their respective columns; expenses that are not entirely charged to any one service are apportioned

on horse power output basis, making the division as between arc, incandescent or power, in the proportion which the horse power used for each bears to the total horse power output.

For the proper division of those accounts not chargeable entirely to any one of the principal departments—for example, the total output of the station being 1,000 horse power, the company operating 500 arc lights, 2,500 incandescent lights and 250 horse power, the division of a bill for boiler repairs, engine repairs, fuel and similar devisable accounts, would be one-half arc lighting, one-quarter incandescent lighting, one-quarter power.

The division to be accurately determined each month.

No intelligent economy can be practiced without a thorough knowledge of the cost in the past and a comparison of the same with the present outlay. Constant comparison of accounts tend to economy. The experience of other companies is a good guide and would be found of great utility.

I would like to urge upon the Convention the importance of the adoption of some uniform classification of expenses that they can recommend to central station managers for their adoption.

It does not follow that central station managers are to expose their books in detail, but to so prepare their accounts that they can give the secretary of the National Association replies to such questions of cost per unit as would be proper to exhibit to the other members.

Such statistics would be of the greatest interest and value ; indeed, it would be of more value than all the other papers combined.

I have a station producing arc and incandescent light and power, earning a moderate dividend for its shareholders, but I have nothing to guide me as to how my

expenses per unit compare with other central stations. I would give much for such information.

Therefore, I conclude that this is one of the most important subjects that can engage the attention of the Association.

CAMDEN LIGHTING AND HEATING CO.

STATEMENT OF EXPENSES FOR....................189

HEADS OF ACCOUNTS.	Arc Lighting.	Inc. Lighting.	POWER.		TOTAL
			St. Cars	Stationary	
Boilers, repairs of					
Belting, "					
Boiler House and Stack, repairs of					
Carbons					
Converters, repairs of					
Clerks					
Dynamo, repairs of					
Dynamo Attendants					
Enginemen and Firemen					
Engine, repairs of					
Fuel					
General Officers' Salaries					
Horses, Wagons and Harness					
Insurance					
Interest on Notes, Bonds and Mortgages					
Incidentals					
Instruments of all kinds					
Lamps, repairs of					
Lamp Supports and Fixtures					
Lamp Globes					
Lamps, Incandescent					
Linemen					
Loss and Damage					
Labor at Station					
Labor on Street Cars					
Legal Expenses					
Meters, repairs of					
Motors, "					
Oil					
Office Expenses, repairs and furniture					
Poles and Lines, repairs and renewals					
Right of Way					
Station, repairs of and furniture for					
Stationery and Printing					
Superintendent and Foremen					
Steam Piping					
Shafting					
Taxes, City					
Taxes, State					
Tools, repairs and renewals					
Trimmers and Inspectors					
Water					
Waste					
Total Expenses for Month					

Total average arc lights, ... Total inc. output in ampere hours......
Total arc light hours, ... Total as shown by meters, ...
Total cost per arc light hour,...... Total loss, ...
Total cost per 100 ampere hours,......

Total stat'y power output in watt hours,......
Total as shown by meters, ...
Total loss, ...
Total cost per 1,000 watt hours, ...

REMARKS.

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CAMDEN LIGHTING AND HEATING CO.

Comparative Statement of Expenses.

HEADS OF ACCOUNTS.	MONTH OF 189..	MONTH OF 189..	INCREASE.	DECREASE.
Boilers, repairs of				
Belting, " "				
Boiler House and Stack, repairs of				
Carbons				
Converters, repairs of				
Clerks				
Dynamo, repairs of				
Dynamo Attendants				
Enginemen and Firemen				
Engine, repairs of				
Fuel				
General Officers' Salaries				
Horses, Wagons and Harness				
Insurance				
Interest on Notes, Bonds and Mortgages				
Incidentals				
Instruments of all kinds				
Lamps, repairs of				
Lamp Supports and Fixtures				
Lamp Globes				
Lamps, incandescent				
Linemen				
Loss and Damage				
Labor at Station				
Labor on Street Cars				
Legal Expenses				
Meters, repairs of				
Motors, "				
Oil				
Office Expenses, repairs and furniture				
Poles and Lines, repairs and renewals				
Right of Way				
Station, repairs of and furniture for				
Stationery and Printing				
Superintendent and Foremen				
Steam Piping				
Shafting				
Taxes, City				
Taxes, State				
Tools, repairs and renewals				
Trimmers and Inspectors				
Water				
Waste				
Total Expenses for Month				

COMPARATIVE STATEMENT OF OUTPUT.

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REMARKS.

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....*Secretary.*

GENERAL STATEMENT OF EARNINGS AND EXPENSES FOR MONTH OF........................189....

EARNINGS

FROM	189....	189 ...	INCREASE	DECREASE
Arc Lighting				
Incandescent Lighting				
Power—St. Cars				
" Stationary				
Miscellaneous Sources				
Total				
		Net		

EXPENSES

EXPENSES OF	189....	189....	INCREASE	DECREASE
Arc Lighting				
Incandescent Lighting				
Power—St. Cars				
" Stationary				
Total				
		Net		

EARNINGS AND EXPENSES, SHOWING NET EARNINGS

FROM ALL SOURCES	GROSS EARNINGS	EXPENSES	NET EARNINGS
Month of			
Same month last year			
Increase			
Decrease			
Jan. 1st to			
Same period last year			
Increase			
Decrease			

DR. BALANCE SHEET CR.

To	*By*

Respectfully submitted, ...*Secretary.*

DISCUSSION.

Mr. Burleigh: I know of the many difficulties in the way of bringing this matter before the attention of the Convention. I know of the many difficulties that beset the way of a uniform classification of accounts. We have all fairly started on our way with our own particular plans; to change them would be embarrassing in many, perhaps in all, cases, but great good would follow a uniform classification. I do not mean that we should all keep our accounts alike, but that we should agree on certain headings for our expense charges, and what items are to go to those expense headings. So that when I hear my neighbor say that his arc light cost him so many cents per arc light per hour, I know what makes that up; I know whether he includes interest or not. Some keep a depreciation account, others do not, and so on.

The forms that are appended have no particular merit over other forms. My whole thought is to get a uniform classification of expenses.

Mr. Nicholls: I have listened with a great deal of interest to this paper, and I shall consider it of more interest still when I have an opportunity of carefully and at my leisure going into the varied detail schedules that Mr. Burleigh has prepared. But, as it may be of interest to the Association, I will draw attention to two points that I have adopted in my own practice, which I find of incalculable value. To begin with, I have two private abstract books, bound, with a lock and key on them, so that while they are kept in the regular vault, they are not accessible. In the first book I have our charter, under which we operate. I have our agreement copied in—our agreement with the city—our franchise. I have our different agreements with the different companies with which we do business. In addition to having all

those put down in this book, I have them indexed and cross-indexed. If I have to refer to any particular clause or agreement as to powers of any kind, I can, by looking at this index, find it at very short notice. I periodically read over these agreements, because there may be a clause in an agreement that you have pigeon-holed which appears of no earthly use to you to-day, but a year from now you may find it gives you certain advantages, or that under that agreement certain rights accrue to you which you have forgotten and which you wish to take immediate advantage of; and I think any central station manager will find a system of that kind a great advantage.

Then, we have a monthly abstract of earnings and expenses. We bring everything right up to the end of the month, and I insist on having it before me not later than the 12th or 15th of the month following. In addition to having that copied out into my private abstract book, I have the cost of our power, as compared to the variable expense of the station, made up to what I estimate at the engine, the bus-bar and the service, allowing for the average drop. I also have the cost of our total power turned out compared with our total earnings. Then, I take our light. I know whether we do our business by the meter basis, and then I figure actually what we get per horse power per hour for our earnings from incandescent lamps and from our meters, and if I am called upon to make a contract at any time, I can tell for every preceding month the average. I can tell what it has cost to produce our power at the engine, at the bus-bar, and at the service, for every month since we have been in operation, and, consequently, I am in a position to know exactly what we are doing. I do not know whether this is the general practice, but I find that it is of very great interest in my experience.

MR. FRANCISCO: There is one point here in regard to Mr. Burleigh's statement, which, it strikes me, would be rather indefinite. I refer to the clause in relation to the proper division of accounts not chargeable entirely to any one of the principal departments. In regard to proper division, with an arc light circuit running commercial lights especially, how are you going to know how much power you are furnishing for your arc lights? And the same may be asked with regard to your power circuits. On a power circuit, sometimes you will have a full load that may last for half an hour; then you will have but a fourth of a load on. The point is, how are you going to tell, in order to fix your divisions here, what proportion to divide among these different branches, and how are you going to make anything accurate? I find it is impossible for me to tell what my engines are carrying at different times. The light is going on and off constantly. Most of my lights are commercial lights. Of course, with the street lighting they are thrown on and off at a definite time, but with the commercial lighting you cannot tell anything about it. Now, how are you going to divide that so as to make anything accurate? The same with regard to Mr. Nicholls' point. As I understand him, he has the card taken from his engine to get at his power. Now, if you take a card at the present time, perhaps in ten minutes from now there will be a hundred horse power taken off and that will remain off twenty minutes, or it may come right back again.

MR. NICHOLLS: I can explain that in a very few words. Although we indicate our engines frequently, we take our power card from our ampere meters. We have the readings of our ampere meters taken down every fifteen minutes. Then, I have a book of 400 pages. We use 365 pages. I have that diagram of the power output, as indicated by the ampere meters, plotted out

on this diagram for the whole twenty-four hours. Last year I had it in black ink; this year I have it on the same page in red ink—the diagram of the ampere output for every quarter of an hour during the twenty-four hours. We run continuously; we never shut down. That is the best approximate means of estimating the power.

In regard to the other matter, I think Mr. Burleigh should properly reply to that.

MR. BURLEIGH: I cannot determine accurately; I only determine approximately. But the fact that I cannot determine accurately does not debar me from getting as near to it as possible. We take our arc circuits, and assume that they are full from the beginning to the end of their run. Mr. Francisco has commercial lights going out at various hours. Our commercial circuits are twelve o'clock circuits and we assume that, from the start to the finish, they are full. Neither can the railroad company down there determine about its charges; how much to charge to passenger, and how much to charge to freight; but they do make a division. Nor do they stop at that division because they cannot determine the exact charge. They make it approximately. They get very near to it—near enough for their purposes—and as all systems charge alike, why, their comparisons are useful.

MR. SCOTT: I do not want to take the time of the Convention, but bookkeeping is my business, and I have a simple way of keeping the account of our station that seems to be applicable to almost any station, because it can be sub-divided. The principle of bookkeeping is like a tree with roots branching out in every direction. Every one of those roots contributes to the central trunk. The ledger is the reservoir of all accounts, and the only true way of keeping books is by a ledger. If

you have a ledger with 1,800 or 2,000 accounts, it need be no more trouble than a ledger of two or three accounts. When you are constructing your plant, you are careful to put all the details of the ledger each under its respective heading; if, in process of time, anything arises to necessitate another of those accounts, you make it. The monthly report to the directors shows that the account has been increased to that extent. I had vouchers printed. For instance, "The Bristol Electric Light and Power Company, to so and so, Debtor." If it is construction account, it goes on a construction voucher; if it is operating account, it goes on operating voucher; if it is a merchandise account—for we have people who buy merchandise of all kinds, as all country stations do—it goes on a merchandise voucher. Then, all you need for a journal is a simple blotter—a twenty-five cent book. You put that, of course, into a cash-book. In the cash-book I sub-divide, by allotting 100 pages to construction, 100 pages to merchandise and 100 pages to operating. The journal entries show:

Cash, Dr., To Sundries:		Sundries, Dr., To Cash:	
By Capital Account,	......	To Construction Vouchers,	......
" Merchandise,	......	" Operating Vouchers,	......
" Lamp Rentals,	......	" Merchandise Vouchers.	......

The posting is direct from those vouchers, and those vouchers have the signature of the foreman who receipted for that bill at the bottom, and also the signature of the President and Secretary, showing that the voucher has been passed at a regular meeting of the Board, and is signed by the Secretary and Treasurer. For instance, "The above accounts have been examined and audited by the Board at a stated meeting, held August 18th, 1891. Received, New York, August 18th, 1891, of the Treasurer of the Bristol Electric Light and Power Company, $125, in full for the above bill." That is the whole business. Then, my ledger accounts will show, as near

as I can recollect them here, capital, surplus, profit and loss, real estate, station, engine No. 1, engine No. 2, engine No. 3, engine No. 4, boilers Nos. 1, 2, etc., engine connections, converters, meters, poles, wire, labor and expenses on line, pins, insulators, etc., merchandise, coal, oil and waste, insurance, taxes, operating expenses (these would be small items that you would not want to keep a regular account for), wages, repairs to real estate, repairs to steam end, repairs to electrical end, maintenance of way and lamps. That constitutes a ledger account from which a balance sheet can be taken every morning and submitted to the Board. If there is an increase in any of those operating accounts, they want to know what it is for. Then, in addition to that, we have a lamp record which is taken from the blotter in the store-room. Each customer's account shows a debit for the lamp issued, with a credit for the lamp returned. Those lamps are all numbered consecutively, and the numbers are entered on the record. Of course, this applies only to incandescent lighting, but it can be varied. The numbers are retained in that record. At the end of a year, or six months, or three months, that lamp record is examined and those renewals are charged in the proper account in the ledger. The Board of Directors have submitted to them monthly a balance sheet from the ledger, and the Board, as a Committee of the Whole, audits these accounts before each meeting of the stockholders, and strikes off for depreciation whatever is thought necessary. For instance, they look over the pole account. They know what the life of a pole is. We charge off 20 per cent. That is safe, the life of poles being pretty well known. We charge off for tools from 25 to 50 per cent., according to the use they are put to, and so we go through each table on that sheet. Then the balance sheet shows a profit and

loss account. The whole shows just exactly what it has cost us to run that station, to supply the number of lamps that is shown by the lamp record. For instance, last year we produced 1,919,000 amperes of current at a cost of 1,110,000 net pounds of coal. That balance sheet account can be got any month, and, in that way, you can get a regular system of bookkeeping, not only of your profit, but your horse power, and all those minor details, and I think that the simpler way you keep those books the better. But, as I say, the ledger must be a reservoir, and every stream must flow into that reservoir.

JUDGE ARMSTRONG: I understand that all of our companies keep their accounts largely on the same model, or with the same end in view. Mr. Burleigh's suggestion was that we get some system so that we could all compare. As it is now, Mr. Scott will call one thing one heading, and we will put the same thing under another heading, or it may be we divide the two, and put a part under another heading, and we do not come to a result which is exactly the same. The grand total will be for our company just exactly the same. We will all arrive at the same conclusion for ourselves. There is no method of comparison at all and Mr. Burleigh's plea is that we throw away our system entirely and take another heading. If you will all agree to do that—you to take ours, or we will take yours—we will do anything so that we can compare the accounts together—and then, if it be found necessary, as Mr. Scott suggests, to divide up one of those headings for our benefit, we can divide it up afterward; we can sub-divide it. Now, in the census count, they are moving on to exactly the same thing, and, in a certain line, we have adopted that. We have agreed, as an Association, to that thing. If, among ourselves, we can agree to it, then it would be possible for me to sit down and write a confidential letter to a

dozen companies and say, "Won't you give me your item of this, that, or the other?" That is all I need to say; they would know what I wanted. Or they could write to me and I could give the same thing. That would be on exactly the same basis. We would have reduced our business then to a science, as well as the thing in which we deal. We can talk about the general principles of it, but in its commercial application we can arrive only partially at anything like a satisfactory account. Mr. Burleigh has been very much interested, I know, to satisfy me, to satisfy our directors, as to these various things and we have been most anxious to make an intelligent comparison with the work done by other people, and, so far, we are unable to do it from anything we can get through the Association. If it is thought desirable to do this thing—and I think the desirability of it must commend itself to every one—I should be very glad if we could have a committee to take that into consideration, and, as an Association, resolve to make some basis upon which we can all meet, upon which we can all agree.

MR. PECK: I would suggest that this is a very important matter and, as we have a Committee on Data, that that Committee be instructed to appoint a Sub-Committee on Station Accounts, and that they gather all the statistics they can before the next meeting, and report as to some general system of station accounts at our next meeting.

MR. BURLEIGH: Speaking to Mr. Peck's suggestion, I doubt if we could ever agree on a uniform keeping of accounts; but we might arrive at a uniform classification of expenses—we might limit it to that.

THE PRESIDENT: I assume that almost every man who has formulated a lot of accounts to carry on his business, thinks that his accounts are, as a rule, kept

about right. Fortunately, or unfortunately, personally, we in Buffalo have had access to as good an accounting system as exists in the country. Members of our company are closely allied to a corporation about which some of you know—it is called the Standard Oil Company. They have a gas interest which is rather far-reaching. What is applicable in the main to the gas interests, is applicable to the electric light interests. We have taken many of the methods that they employ in accounting and, in fact, our books are practically what they have. From time to time it has seemed wise to make changes and invariably when those changes are suggested to the accountants of the office they look very tired, and say, "I have got all the work I can do; this is more than I can take care of;" and where one has a large station to care for, he must necessarily entrust that to his chief engineer, or his chief dynamo man, or those in charge of the station, and the repairs and material there have to be accounted for by him. They have, as a rule, no ability as clerks. They are handy with a lead pencil and they can memorize things fairly well. We have got out a lot of blanks which seem to cover the ground fairly. All our material is charged to the station and as each dynamo has its work to perform, we have whatever that dynamo costs. All the parts of that dynamo are printed up, and as we are operators of a system that sometimes burns out an armature, we have a diagram on the back, showing the bobbin of each armature, and we indicate when that armature burns out, and the cause of it. At the end of the month, those are sent into the office and the items are extended out into dollars and cents, and carried out into expense and maintenance of the dynamo. That is true of the boilers and engines and our line of repairs and general construction work. We have what is called a voucher ledger and at the end of the month

the bookkeeper has only one entry to make in his ledger. There is nothing done in the ledger other than August, September—whatever date it may be—so much. But that voucher is carried out into 20 different columns. At the end of the month you can see exactly what those items are—whom you paid this money for—and then refer back to the voucher, which is, as a rule, audited before any account is taken of it, both where we are buying goods and where we make other entries—having two different colors of paper to indicate our purchases and our disbursements. That simplifies bookkeeping, and with the very many accounts which we now have we find, for a business of our size, that we handle them very easily, and at the end of the month we know exactly how much our expenses have been for that month, and if the Board cares to look into the details of it, they can be easily obtained. But we have one column which shows what our expenses have been, beginning with the first of January, and the excess or decrease of expenditure, as the case may be, using red ink for increase, and black ink for decrease—and that is carried on from month to month. That serves the purpose very well with us, and it serves the purpose very well with the gas interests of the Standard Oil Company, as well as with their other interests. When we make an installation of a plant or building, we have a form, and everything is put down on that. That form is countersigned by the superintendent and foreman of the construction gang. The prices are carried out in each individual case and that is pinned to the contract. That disposes of that in a manner peculiar to ourselves, and we charge off a certain amount to profit and loss. When that service is discontinued, we have got an investment in this customer. We can go at once to the contract and find that his contract has cost us $25 to install that place.

We have cut-out, switch, and all those appliances in that building, so much wear, and other things. When that comes back to the store-room, there is an accounting made to the office. Our store-rooms and stations are supplied, then a comparison is made of what is left of that stuff. The original entry is there with the contract, and what comes back to the store-room from that place is accounted for. In very great losses, we inquire where this stuff has gone to, and we find that since adopting that system it has resulted in more care on the part of the various men in bringing back the wire, converters and other appliances in the places.

In the matter of cash, we have a daily statement, which, I assume, almost everybody has. Many of the blanks that we use are very like Mr. Foster's, although I think he has gone into a more elaborate accounting than we employ. But I think that with us it is almost imperative that the thing should be as simple as possible, on account of the bookkeeping in the establishment. While it is very desirable to have a good system of accounting, if we should employ an elaborate set of blanks—and the results, of course, are desirable to a few—it costs a thousand or twelve hundred dollars a year more to obtain. Perhaps the end would justify the means. I have no doubt it would. I would say here that if any member of the Association would like a copy of what we have there, I should be very glad to forward blank sheets of our voucher record, and other books and blanks to them. I have already sent out quite a number of them, and I think Mr. Ayer and a few others have them. But it is not anything for which we can take any great credit to ourselves, for the reason that I stated.

On motion of Mr. Seely the convention then adjourned until September 10th, at 10 A. M.

ORDER OF BUSINESS.

THURSDAY, September 10, 1892.

FOURTH SESSION, 10 A. M.

1. Announcements.
2. Paper, "Three Years' Development of Electric Railways."
   By CAPT. EUGENE GRIFFIN, Boston.
3. Topic, "Statistics of Electrical Industries."
4. Discussion, Rules for Safe Wiring.
5. Paper, "Electric Railroad Construction and Operation."
   By C. J. FIELD, New York.

FOURTH SESSION.

The Convention was called to order by the President at 10 A. M.

ANNOUNCEMENTS.

The President read an invitation from the Business Men's Association, of Norfolk, Va., to hold the next meeting of the Association in that city.

Also invitations from Robert M. May, Mayor of Augusta, Ga., the Cotton Exchange, the Exposition Company and the Commercial Club, of Augusta, to hold the next meeting of the Association in Augusta.

On motion of Mr. Armstrong, the invitations were received, and referred to an executive session.

THE PRESIDENT: The first business in order this morning will be the reading of the paper by Captain Eugene Griffin, entitled "Three Years' Development of Electric Railways." The copies of the paper have not yet come from the printer, but will be received in time for distribution this afternoon.

CAPTAIN GRIFFIN: I feel that a few words of apology are due with reference to the paper that I am about to present. I was asked some time since to write a paper for this Convention, and was given ample time in which to do it; but, as you all doubtless know, the pressure of electrical business is something quite anomalous at the present time, and I have found myself so occupied with business that I have had very little time to devote to this paper. The result is that the paper was not written until Saturday and Sunday last, and was not typed until day before yesterday. I, therefore, beg your indulgence in what I have to say, in view of the very short time I have had in which to collect these facts.

Captain Griffin then read the following paper:

THREE YEARS' DEVELOPMENT OF ELECTRIC RAILWAYS.

The first recorded description of the electric car is found in the fourth verse of the second chapter of Nahum: "The chariots shall rage in the streets; they shall jostle one against another in the broadways; they shall seem like torches; they shall run like the lightnings."

Notwithstanding this early mention, it was not until 1888 that the electric railway became a practical commercial success. I fix the date at 1888, as it was in that year that Bentley and Knight opened the Allegheny City road to regular traffic; that the Sprague Company equipped the Richmond road, and the Thomson-Houston Company installed the Eckington and Soldiers' Home road in Washington. It was in 1888 that railway officials began to realize the possibilities of this new tractive force; that the great West End system of Boston adopted electricity to the exclusion of cable, and that orders began to flow in upon the electric companies for street car motors to such an extent as to soon make the manufacture of such motors one of the leading branches of the electric industry.

Previous to 1888, electric motors had been used on several roads. Some of these roads were doing well and have been prosperous since; but to the public these were experiments on a comparatively small scale, and did little to inspire general confidence. The early inventors found it difficult to secure adequate financial backing;

orders were few and business unprofitable. The stronger companies which took up the work in 1888 had the organizations and capital necessary to achieve success.

The pioneers who devoted their brains, and frequently their purses, to this work previous to 1888, are deserving of all credit. It was their misfortune, not their fault, that their ideas were not developed and worked commercially. It is difficult for one man to combine the qualities of inventor, manager, superintendent, seller, expert and financier, and yet this is what Van Depoele, Daft, Bentley and Knight and others had to attempt. The record of their efforts is an interesting one, but the chronological record of electric traction has been so frequently given that it would be a waste of your time to repeat it again.

There are, however, one or two of the early trials that are specially worthy of consideration, not only because of what was actually accomplished, but principally on account of their bearing on later developments. On the 27th of July, 1884, an electric car was running scheduled trips over a mile of track of the East Cleveland Street Railway Co., in Cleveland, Ohio. This was the first electric car in regular operation on a street railway track in the United States. The motor was placed between the wheels and supported from the car body and geared to the axles by belts of spring wire cables. The current was conveyed to the car by conductors supported on insulators in a small, wooden conduit, and connection made with the conductors by means of a plow extending through the slot to the conduit. This was the initial installation of the Bentley & Knight system. Mr. Bentley has a photograph of the car in his office in Boston.

The road was given up in 1885, and the Bentley-Knight works transferred to Providence, R. I. After various experiments, the road in Allegheny City was

begun in the summer of 1887. The cars were started during the winter of 1887-'8, although the road was not formally opened to traffic until February, 1888. Four cars were furnished to this road, which, I believe, are still running. On the lower end of the road was a mile of double track conduit, which was continued by an overhead system of about five miles. The conduit was on a long grade of about 12 per cent. Over-running trolleys were used with the overhead system. The conduit was in operation for two years or more, but has now been taken up and replaced by the overhead system.

As early as 1874, while C. J. Van Depoele was engaged in Detroit, experimenting with electric motors, generators, etc., it occurred to him that trains of cars, and even ordinary street cars, could be run by electricity. This was demonstrated to the satisfaction of his associates in various ways, but no public exhibition was made until 1883. When the Chicago elevated railway was under consideration, it was proposed to demonstrate the feasibility of utilizing electricity as a motive power. A track 400 feet in length was built, with a 5 per cent. grade in the centre. One car was equipped with a 3 horse power motor and ran for several weeks with considerable success, carrying crowds of people. This was in February, 1883. In the same year an elevated railway car was operated electrically at the Chicago Inter-State Fair. The car was suspended from the truck instead of being mounted on it, and was in operation during the entire exposition —some fifty days.

During the Toronto Annual Exhibition in 1884, an electric railway, some 3,000 feet long, was operated from the entrance to the grounds to the main building. This was a conduit road and the wires carried a potential of over 1,000 volts without accident. A 30 horse power electric locomotive was used, hauling trains of cars.

The Van Depoele Company subsequently equipped roads at Minneapolis, Minn.; Montgomery, Ala.; Detroit, Mich.; Windsor, Ont.; Appleton, Wis.; Port Huron, Mich.; Scranton, Pa.; Lima, O.; Binghamton, N. Y.; Ansonia, Conn.; Dayton, O.; Jamaica, N. Y.; St. Catherines, Ont., and elsewhere, many of which are still in operation.

In the fall of 1887, Frank J. Sprague contracted for the electrical equipment of the Union Passenger Railway, at Richmond, Va. This was an important road in a large city and Mr. Sprague's undertaking was the most ambitious effort in this direction up to that date. It is worthy of note that Sprague's original intention was to use motors with but one reduction, but he was forced to abandon this idea, as none of the electrical companies at that date were able to produce single reduction motors. The motors used at first were too light for the work; the copper brushes scored the commutators badly and were rapidly consumed. Nevertheless, Mr. Sprague persevered, despite all obstacles, and in 1888 the road was running with so much success that it was one of the object lessons which induced Henry M. Whitney and his brother directors of the West End Street Railway, of Boston, to adopt electricity as a motive power when they were already far advanced in the plans for cabling their system.

As nearly as can now be ascertained, the following electric roads were actually in operation on January 1st, 1888:

ROADS	SYSTEM	LOCATION	Miles	No. of Mtr. cars
Union Pass. Ry. Co.	(Daft)	Baltimore, Md.	2.00	3
Windsor Electric Ry.	(Van Depoele)	Windsor, Ont.	1.25	2
Appleton " "	" "	Appleton, Wis.	5.50	5
Port Huron " "	" "	Port Huron, Mich.	2.75	4
Highland Park	(Fisher)	Detroit, Mich.	3.25	4
Scranton Suburban Road	(Van Depoele)	Scranton, Pa.	5.00	12
Los Angeles Electric Ry. Co.	(Daft)	Los Angeles, Cal.	5.00	6
Lima Street Ry. and Motor Power Co.	(Van Depoele)	Lima, O.	4.00	8
Columbus Consolidated Street Ry.	(Short)	Columbus, O.	1.00	2
St. Catherines Street Ry. Co.	(Van Depoele)	St. Catherines, Ont.	7.00	12
Seashore Electric Ry. Co.	(Daft)	Asbury Park, N. J.	4.00	18
San Diego Street Ry. Co.	(Henry)	San Diego, Cal.	3.00	9
East Harrisburg Pass. Ry. Co.	(Sprague)	Harrisburg, Pa.	4.50	10

A total of 13 roads, 48.25 miles of track and 95 cars.

On July 1st, 1891, there were 354 roads in actual operation, with 2,893 miles of track equipped electrically, and 4,513 motor cars. Such has been the growth of three and a half years.

This development has been marvelous and unprecedented. Referring to it, General Francis A. Walker said to me, not long since, that it seemed as though at least thirty years normal development has been crowded into three years.

It has, indeed, been a fruitful period, and the progress has been so rapid that the public are just beginning to appreciate the benefits which science has conferred upon them by the adaptation of the electric motor to street car propulsion.

During the past spring the Legislature of the State of Massachusetts was considering a proposition which practically amounted to the imposition of new taxes upon the West End Street Railway Co., and the abrogation or virtual annullment of certain vested rights which the com-

pany might claim. In his able and vigorous defense of his corporation, President Whitney was forced to investigate and determine the true relations which exist between his company and the public, and he was surprised himself to see how closely the welfare of the city of Boston and its surrounding suburbs was identified with the welfare of its street transportation system.

He at once entered upon a "campaign of education," and his speeches in Somerville, Roxbury, Dorchester and elsewhere (several of which have been published in pamphlet form), are masterly, impressive, straightforward and convincing presentations of the close relations which exist between the rapid transit systems and the health, wealth, morality and prosperity of our large cities.

I commend these speeches to the consideration of you all. I have not hesitated to draw from them largely myself.

I consider this growing realization of the true position which transportation companies occupy in respect to the public as one of the most important of recent developments, and it may be well to give it some consideration.

The officers and directors of a street railway company are quasi public officers with most important and serious duties devolving upon them. Their duty to their stockholders is to see that the company is economically and efficiently administered so as to produce a fair return upon the capital invested. Their duty towards the public is to see that the best possible transportation facilities are afforded, having in view "the greatest good of the greatest number." This broad statement of their public duty is unquestionably true, and yet the failure to appreciate this axiom is the most fertile source of adverse criticism of railway management. The critic almost in-

variably argues from a personal standpoint. If he would only remember that the road is run for the benefit of the masses and not for his personal individual benefit, the lives of general managers would be made less burdensome.

The last census has clearly shown a strongly-marked tendency of our population to gravitate towards the large cities. In every State the percentage of growth in cities is far greater than in towns and villages. Such condensation of population means an increase of the tenement house system in contradistinction to the cottage system, a crowding of people beneath each roof, an increase in vice, immorality, misery, crime and the death rate. How is it to be avoided? The laborer must live near his work, near in time and near in money. He can spare but a fraction of his time, but a fraction of his day's wages, in going to and from his work. If the zone fare system exists, as in Europe, the area within which he can live is limited by this consideration. Two cents per mile might restrict him to a radius of two and one-half miles (five cents). If the single-fare system prevails, as in this country, time is practically the only restriction. Let us assume that he can allow thirty minutes morning and evening for his car ride, paying five cents for each ride. At the rate of six miles per hour, fast for horses, he has a radius of three miles and an area of twenty-eight and one-quarter square miles within which to select a home. At the rate of nine miles per hour, slow for electricity, he has a radius of four and a half miles and an area of sixty-three and a half square miles within which to select a home. This example suffices to illustrate the point. An increase of only three miles per hour in rapidity of transit doubles the available residence area without increasing the time or expense of the laborer in going to and from his work.

The steam road, the elevated road, the underground road and the cable, each and all afford rapid transit; but their application is restricted within very narrow limits, because of their great cost, while the electric roads can be profitably extended in all directions.

The great advantage of increasing the available residence area, of encouraging the cottage system and discouraging the tenement system, will be readily conceded by all. The health and morality of a great city are universally proportional to the number of people beneath each roof. The electric railway is one of the great moral agents of the nineteenth century.

The experience of the past three years has settled many disputed questions, resolved many doubts, systematized methods and improved construction.

A variety of styles, systems and methods were used prior to 1888. We had storage batteries, conduits and overhead wires, single trolley and double trolley wires, over-running trolleys and under-running trolleys.

Storage batteries have made little progress. They have nowhere scored a pronounced success, and have been abandoned on nearly every road. They are but little considered in the field of electric traction, except in reference to future possibilities.

The very few conduits built have disappeared and have been replaced with overhead wires. The overhead wire is now generally recognized as the only practical method of conveying electricity from the generator to the car motor.

The objections to overhead wires have been, and in many places still are, very strong; but actual experience has shown that the objections are not well founded. Wires are not an ornament to the street, and objections on this ground will always exist; but lamp-posts, signs, railway tracks and many other similarly useful objects,

are not ornaments. Overhead wires will never be condemned on this ground alone. Objections on the score of unsightliness become of less and less importance each year, as the methods of construction are improved and the public appreciate more freely the benefits of electric motive power.

One of the early apprehensions in reference to the use of overhead wires was the possible danger to life from the current used. On this point I think the public are now well satisfied. While there are few employees on any of the roads now in operation who have not had the full shock of 500 volts repeatedly, there is not a single instance of any of the patrons of these roads having been killed or even seriously injured by the 500 volt current from the overhead wire. Electric cars will run over and kill the careless pedestrian or the drunken passenger who falls from the platform in front of the wheels as will the horse car, but no passenger or pedestrian has ever been killed by the trolley wire, and statistics do not show that the electric car is in any respect more dangerous to life than the horse car or cable car. Last year (1890) the West End Street railway system of Boston carried 114,853,081 passengers and all the steam railroads of the whole state of Massachusetts only carried 98,843,712. The West End system killed 15 passengers and employees and the steam roads killed 325. Of the 15 fatal accidents on the West End system, 5 were attributable to electric cars and 10 to horse cars. It is only fair to say that the narrow and crooked streets of Boston, and the enormous traffic of the West End system, are conditions peculiarly conducive to accidents.

The fear of the electric current is one born of ignorance, and time alone can overcome it.

In the year 1889, nine human beings were killed by

the arc light wires in New York City (2,500 volts) and the authorities were roused to such a pitch of frenzy that the poles were chopped down and a large part of the city left in darkness. Yet, with perhaps one exception, all of the victims were employees of the lighting companies and suffered because of failure to observe proper and well known precautions. In the same year, 12 persons were asphyxiated by gas and over 30 were killed by signs and other objects falling on their heads as they walked peacefully along the streets.

In time we are able to estimate every danger relatively, but in the beginning unknown dangers, those to which we are not accustomed, are greatly exaggerated.

Ralph W. Pope, in a very interesting paper read before the Franklin Institute last year, gives some curious illustrations of this tendency to magnify unknown dangers and arrest the progress of improvement. I quote:

"In an article, entitled 'How Our Ancestors Traveled,' we find the following pertinent observations on the subject:

"Carriages met with great opposition at their first introduction, and laws were made to suppress their use. As early as the year 1294, Philip the Fair, of France, issued an ordinance for suppressing luxury, in which the wives of citizens were forbidden the use of carriages. Beckmann tells us that there is preserved in the achives of the County of Mark, an edict, in which the feudal nobility and vassals are prohibited from using coaches under pain of incurring the punishment of felony. Duke John, of Brunswick, published an order in 1588 roundly rating his vassals for neglect of horsemanship, and forbidding them to appear or travel in coaches. A few years after this the English Parliament took up the discussion of the subject; but, on the 7th of November,

1601, the bill to restrain the excessive use of coaches within the realm of England was rejected. But the bitterness of antagonism to them did not cease with this legislative decision. In a pamphlet called the 'Great Concern of England Explained,' published 1673, the writer very gravely attempts to make out that the introduction of coaches was ruining the trade of the realm. Following is an example of his method of reasoning: 'Before coaches were set up, travelers rode on horseback, and men had boots, spurs, saddles, bridles, saddle-cloths and good riding suits, coats and cloaks, stockings and hats, whereby the wood and leather of the kingdom were consumed. Besides, most gentlemen, when they traveled on horseback, used to ride with swords, belts, pistols, holsters, portmanteaus and hat cases, for which in these coaches they have little or no occasion. For when they rode on horseback, they rode in one suit and carried another to wear when they came to their journey's end; but in coaches they ride in a silk suit, silk stockings, beaver hats, etc., and carry no other with them. This is because they escape the wet and dirt, which upon horseback they cannot avoid; whereas, in two or three journeys on horseback, these clothes and hats were wont to be spoiled; which done, they were forced to have new very often, and that increased the consumption of manufacture.' In another part of his pamphlet, the same writer puts the following query, evidently with the notion that it was a clincher: 'Is it for a man's health or business to be laid fast in four ways; to ride all day with strangers, often times sick, diseased, ancient persons, or young children crying, all whose humors he is obliged to put up with, and crippled with their boxes and bundles?' As an additional objection against the introduction of coaches, the writer urges

that they would discourage the breeding and lessen the value of horses.

"The following passage occurs in a protest against the construction of railways, which is preserved in the achives of the Nurnberg Railway, at Furth, which was the first line constructed in Germany. It was drawn up by the Royal College of Bavarian Doctors:

"Travel in carriages drawn by a locomotive ought to be forbidden in the interest of public health. The rapid movement cannot fail to produce among the passengers the mental affection known as Derlirium Furiotum. Even if travelers are willing to incur this risk, the Government should at least protect the public. A single glance at a locomotive passing rapidly is sufficient to cause the same cerebral derangement, consequently, it is absolutely necessary to build a fence ten feet in height on each side of the railway."

"These were all European, however, so in order to assure you that these peculiar views were held in our country, the following protest from the good citizens of Philadelphia, in 1833, against the introduction of gas, will be of interest to you:

Philadelphia, November 28th, 1833.

REMONSTRANCE AGAINST LIGHTING WITH GAS.

"*To the Honorable, the Select and Common Councils of the City of Philadelphia:*

"GENTLEMEN: The subscribers beg leave to respectfully remonstrate against the plan now in action for *lighting the city with gas,* as they consider it a most offensive, inexpedient and dangerous mode of lighting. In saying this they are fully sustained by the accounts of explosions, loss of life and destruction of property where this mode of lighting has been adopted.

"We consider gas to be as combustible as gunpowder and nearly as fatal in its acts; as regards the immense destruction of property, we believe that the vast number of fires in New York and other cities may be, in a great measure, ascribed to this mode of lighting. The leakage of pipes and carelessness of stopping off the gas furnish almost daily instances of its destructive effects. And when we consider that this *powerful and destructive agent* must necessarily be left often to the care and attention of youth and domestics and careless people, we only wonder that the consequences are not more *appalling.* It is also an uncertain light, sometimes suddenly disappearing and leaving streets and houses in total darkness.

"The waters of the Delaware and Schuylkill, now considered the most pure and salubrious in the world, as many long voyages have fully tested, must soon, we fear, experience the deterioration which has reduced the water of the Thames to the present impure state, for no reservoir will be able to contain such fetid drains from such an establishment, and very soon the rivers must be their receptacle, to the destruction of the immense shoals of shad, herring and other fish with which they abound; the same cause must produce the same effect. Salmon, smelts and other fish formerly caught in vast quantities in the Thames have nearly all disappeared. The constant digging up of the streets, the circumstances of the gas pipes, which, at the intersection of each square, must come in contact with the water pipes, are difficulties and evils which we would anxiously avoid.

"In conclusion, we earnestly solicit that the *lighting our city with oil may be continued.*

"And your petitioners, etc.

"Signed by 1,200 of the leading citizens of Philadelphia, whose names are attached hereto, such as Horace Binney, Hartman Kuhn, Jacob Ridgway, Paul Beck,

Henry Pratt, Benjamin Chew (on whose farm the battle of Germantown was fought), John Sargeant, Charles Wharton, Richard Willing, Edward Pennington, Robert Baux, Joshua Longstreath, Matthew Newkirk, and 1,200 others.

"N. B.—The above are only part of the names, as many of the remonstrances have not yet come in."

The double and single trolley systems have each had ardent advocates, but three years' experience has decided the question in favor of the single trolley and the ground return.

In July, 1888, several roads were using the over-running trolley and it was a question whether the over-running or under-running system was preferable. Three years have decided this question also, and practically all of the electric roads of to-day operate with under-running trolleys. The "fish-pole" of 1888 has been supplanted by the neat steel rod of 1891, and the "broomstick train" can no longer be spoken of with disrespect as regards outward appearances.

Three years have not passed without much litigation, and already we have historical cases finally determined which tend to fix the legal boundaries of the rights of electric railways. Some of these decisions are of great importance.

The telephone companies have quite naturally been ardent advocates of the double trolley, and to avoid suffering from the induced currents of the single trolley, they have sought to induce the courts to compel railway companies to use metallic circuits. A recent decision of the Supreme Court of the State of Ohio is a fair statement of the present legal aspect of this question:

Single Trolley System vs. Double Trolley.

(Supreme Court of Ohio.)

Syllabus.

1. The dominant purpose for which streets in a municipality are dedicated and opened, is to facilitate public travel and transportation, and in that view, new and improved modes of conveyance by street railways are by law authorized to be constructed, and a franchise granted to a telephone company of constructing and operating its lines along and upon such streets, is subordinate to the right of the public in the streets for the purpose of travel and transportation.

2. The fact that a telephone company acquired and entered upon the exercise of a franchise to erect and maintain its telephone poles and wires upon the streets of a city, prior to the operation of an electric railway thereon, will not give the telephone company, in the use of the streets, a right paramount to the easement of the public, to adopt and use the best and most improved mode of travel thereon; and if the operation of the street railway by electricity as the motive power, tends to disturb the working of the telephone system, the remedy of the telephone company will be to readjust its methods to meet the condition created by the introduction of *electro-motive* power upon the street railway.

3. Where a telephone company, under authority derived from statute, places its poles and wires in the streets of a municipality, and in order to make a complete electric circuit for the transmission of telephonic messages, uses the earth, or what is known as the "ground circuit," for a return current of electricity; and where an electric street railway afterwards constructed upon the same streets, is operated with the "Single Trolley Overhead System," so called, of which the ground circuit is a

constituent part; if the use of the ground circuit in the operation of the street railway interferes with telephone communication, the telephone company, as against the street railway, will not have a vested interest and exclusive right in and to the use of the ground circuit, as a part of the telephone system.

The telephone companies have been beaten in every case, and the fact has been definitely settled that railway companies may use a single overhead trolley wire and a ground return without infringing any rights of the telephone companies.

Many interesting legal questions have arisen in reference to line construction.

Objection was made by the summer residents of Newport to the construction of an overhead electric railway, and eminent counsel was employed to place every possible legal obstacle in the way. The case was carried to the Supreme Court of the State of Rhode Island for determination of some of the novel points involved, and one of these points was:

Are Poles and Wires an Additional Servitude upon the Streets?

The court held:

"The fourth ground alleged is that, if the act of incorporation authorizes the use of electricity for the operation of said street railway, and the erection of the poles as ancillary thereto, it is unconstitutional and void, because it authorizes the imposition of additional servitude upon the streets, without providing for any additional compensation to the owners of the fee of said streets. We think it is settled by the greater weight of decision that a railroad constructed in a street or highway, and operated by steam in the usual manner, imposes a new servitude and entitles the owner of the fee to an additional compensation; but that a street railway operated

by horse power, as such street railways are ordinarily operated, does not impose any new servitude, and does not entitle the owner of the fee to any additional compensation.

"The distinction is not often stated as a distinction between steam and horse railroads; but the distinction properly rests, not on any difference in motive power, but on the different effects produced by them respectively on the highways or streets which they occupy. A steam railway is held to impose a new servitude, not because it is operated by steam, but because it is so operated as to be incompatible with the use of the street in the other usual modes, or, in other words, so as practically to exclude the usual modes of use.

"A steam railroad on a street, so operated as to be consistent with the use of the street in the usual modes, has been held not to impose a new servitude.

"It is not the motor, but the kind of occupation, whether practically exclusive or not, which is the criterion.

"The only considerable privilege which the horse car has over other vehicles, is that, being confined to its tracks, it cannot turn aside for other vehicles, while they are forced to turn aside for it; but this is an incidental matter, insufficient to make the horse railroad a new servitude.

"The street railway here complained of is operated neither by steam or horse power, but by electricity. It does not appear, however, that it occupies the streets or highways any more exclusively than if it were operated by horse power.

"Reference has been made to cases which hold that telegraph or telephone poles and wires erected on streets or highways constitute an additional servitude, entitling the owners of the fee to additional compensation; and

from these cases it is argued that the railway here complained of is an additional servitude, by reason of the poles and wires which communicate its motive power. There are cases which hold as stated, and there are cases which hold otherwise, but, assuming that telegraph and telephone poles and wires do create a new servitude, we do not think it follows that the poles and wires erected and used for the service of said street railway likewise create a new servitude. Telegraph and telephone poles and wires are not used to facilitate the use of the streets where they are erected for travel and transportation, or, if so, very indirectly so; whereas the poles and wires here in question are directly ancillary to the uses of the streets as such, in that they communicate the power by which the street cars are propelled."

In the purely technical field all obstacles have been overcome. Like Perry, "We have met the enemy and they are ours." The severe strain imposed by railway work on the generating plant has necessitated the development of new types of engines, and the fluctuations of the dynamos have been prevented by compound winding and series coils. Self-regulating dynamos are now considered necessary in any well-planned power plant.

I attended the exposition at Bremen, in North Germany, last summer, and had the pleasure of riding on an electric railway operated by two 80 horse power Thomson-Houston dynamos. One dynamo was driven by a 70 horse power Armington & Sims engine, and one by a 125 horse power German engine. So closely did the small American engine regulate that no variation in potential could be observed under the most violent and sudden variations in load. Notwithstanding its greater power, the German engine was slow to respond and the variations in speed were marked. I was subsequently in-

formed that a medal was awarded to the American engine, although it had not been entered as an exhibit.

This is indicative of the enterprising way in which the inventors and manufacturers of the United States have met the new conditions imposed by the adoption of electricity as a motive power.

The difficulties Mr. Sprague encountered in Richmond in using copper brushes have now been avoided by the introduction of the carbon brush, for which we are indebted to Mr. C. J. Van Depoele.

As early as 1883–4 Van Depoele used carbon brushes with his motors. When the Van Depoele Electric Manufacturing Company was purchased by the Thomson-Houston Company in 1888, Van Depoele went to the Lynn factory of the latter company. Many did not then consider the carbon brush as practicable, and it was some time before Mr. Van Depoele had an opportunity to demonstrate its possibilities. When the time did come its great value was so apparent that it was at once adopted for motor work and subsequently has been used exclusively with generators.

Since the general adoption of the present method of mounting the motors directly on the axles, double reduction motors have been used. The supposed necessity of high speed of revolution in the armature made this obligatory. In 1890 it was found practicable to make motors in which the armature revolved at a slower rate, and a single gear sufficed for the now greatly reduced reduction. From 10 and 12 to 1 with the old motor we come to 4½ to 1 with the new motor. The gears are enclosed in boxes and run in oil, so that the noise has been reduced to a minimum, the offensive noise of the gears being practically eliminated. We have also gearless motors with no reduction and no gears.

Generator construction has kept pace with the improvements.

As large stations have been built generators have increased in size, and electrical companies are now producing 500 horse power dynamos as readily as the steam engine builders respond to similar demands.

We have learned what it costs to operate electric railways and the result is gratifying. In 1888 it was prophesied that, while electric roads might make good showings so long as the apparatus was new and curiosity riding lasted, in a short time the machinery would begin to wear out and the roads would be swamped by the great repair bills. In reality we find the almost universal testimony is that the longer the road runs, the less is the cost of repairs. This is, of course, not due to the fact that the apparatus improves in quality with age, but the explanation is to be found in the very simple fact that as small defects are eliminated and the employés become more experienced and the organization is perfected, the apparatus is better cared for and injuries are prevented.

A very conspicuous example of this is the West End Street Railway, which has been under my own immediate observation.

In the contract between the Thomson-Houston Electric Company and the Railway Company it was provided that we should keep the overhead line and electrical apparatus on the cars in repair at a given price per car mile. There were many reasons which influenced us to enter such a contract, but the chief reason was that this was the uncertain element in the operation of an electrical railway, and unless this uncertainty could be eliminated, the West End would not make any contract. The cost of these repairs has steadily decreased, and on the 1st of October the West End Company avail them-

selves of the option and relieve us of this part of our contract, knowing there is now no uncertainty and that they can do the work themselves for less money than they pay us.

Some months since President Whitney gave to the public the detailed figures, showing the receipts and operating expenses of the West End road. These are of very great interest to all, and I give them in full, for the purpose of drawing some conclusions from them :

THE ELECTRIC SYSTEM.

	April.	May.	June.	July.
Gross receipts	$134,321	$144,638	$153,988	$144,552
General expenses	8,193	7,796	7,465	6,955
Track and car expenses	47,447	45,443	39,629	43,891
Motive power	30,194	30,924	26,359	26,398
Total operating expenses	85,834	84,163	73,459	77,249
Net earnings	48,487	60,475	80,529	67,303
Miles run	394,459	376,321	360,567	377,191
Ratio of mileage	26.68	25.58	25.15	25.19
Per cent. operating expenses	63.36	58.18	47.70	53.44
Earnings per mile run	34.05	38.43	42.71	38.32
Expenses per mile run :				
Motive power	07.66	08.22	07.31	07.00
Car repairs	01.39	01.33	01.18	01.17
Damages	00.75	00.89	00.16	00.12
Conductors and drivers.	07.33	07.36	07.25	06.92
Other expenses	04.63	04.56	04.47	05.37
Total expenses per mile run	21.75	22.36	20.37	20.48
Net earned per mile run	12.30	16.07	22.34	17.84

HORSE CAR SYSTEM.

	April.	May.	June.	July.
Gross receipts	$344,396	$374,605	$395,555	$409,878
General expenses	22,514	22,682	22,217	20,657
Track and Car expenses	136,693	127,902	125,393	135,954
Motive Power	117,740	118,972	116,210	116,271
Total operating expenses	276,947	269,556	263,825	272,888
Net earnings	67,449	105,049	131,729	136,990
Miles run	1,083,887	1,094,683	1,073,718	1,120,377
Ratio mileage	73.32	74.42	74.85	74.81
Per cent. operating expenses	80.62	71.95	66.70	66.58
Earnings per mile run	31.77	34.22	36.85	36.58

	April.	May.	June.	July.
Expenses per mile run:				
Motor power	10.86	10.86	10.83	10.38
Car repairs	00.93	00.60	00.61	00.61
Damages	00.78	00.37	00.15	00.06
Conductors and drivers	08.24	08.24	08.25	08.23
Other expenses	04.70	04.55	04.24	05.07
Total expenses per mile run	25.55	24.62	24.58	24.35
Net earned " " "	06.22	09.60	12.27	12.23

THE ENTIRE SYSTEM.

	April.	May.	June.	July.
Gross earnings	$478,717	$519,244	$549,543	$554,431
General expenses	30,707	30,478	29,683	27,613
Track and car expenses	184,141	173,344	165,027	179,853
Motive power	147,933	149,896	142,570	142,670
Total operating expenses	362,781	353,720	337,284	350,137
Net earnings	115,935	165,524	212,250	204,294
Miles run	1,478,346	1,471,004	1,433,785	1,497,568
Ratio of mileage	100	100	100	100
Per cent. operating expenses	76.82	68.12	61.37	63.15
Earnings per mile run	32.39	35.29	38.33	37.02
Expenses per mile run:				
Motive power	10.01	10.19	09.94	09.53
Car repairs	01.05	00.79	00.76	00.75
Damages	00.77	00.50	00.15	00.07
Conductors and drivers	08.03	08.01	08.00	07.91
Other expenses	04.68	04.55	04.67	05.12
Total expenses per mile run	24.54	24.04	23.52	23.38
Net earned per mile run	07.85	11.25	14.81	13.64

Taking the June figures, it will be noticed that the net earnings per electric car mile exceed the net earnings per horse car mile by 10.07 cents, while the operating expenses of the horse car lines exceed those of the electric car lines by 4.20 cents per car mile. The difference is 5.86 cents per car mile, which is the gain to the company, due solely to the public satisfaction with the electric service. Mr. Arthur Jones, of the Thomson-Houston International Company, first produced this figure, which he calls the "satisfaction figure."

The net earnings per electric car mile exceeded the net earnings per horse car mile by the following amounts:

In April	6.08	cents	per car	mile.
" May	6.47	"	"	"
" June	10.07	"	"	"
Mean	7.54	"	"	"

The net earnings of the horse cars for the three months averaged 9.36 cents per car mile, hence the electric car showed a gain of 80 per cent. in the net earnings per car mile over the horse cars.

For the three months we have the following figures for the electric cars:

Total receipts	$432,947
" expenses	243,456
Percentage of expenses to receipts	56 per cent.

In St. Paul and Minneapolis, with a combined population of 350,000, there is to-day not one single horse car. Minneapolis has 120 miles of electric railways, all equipped with the overhead system, and St. Paul has 75 miles of electric railways and 15 miles of cable. Most of the cable mileage is to be abandoned and supplanted by electricity. The last car horse disappeared from the streets of Minneapolis in June of this year. The July report of the Minneapolis system shows:

Gross earnings	$107,571
" expenses	52,585
Net earnings	54,985
Percentage of expenses to receipts	49 per cent.

Cleveland, Buffalo, Rochester, Toledo, Omaha, Cincinnati, and many other large cities, are now operating their street cars almost exclusively with electric motors, and the universal testimony is favorable to the increased facilities afforded the public and the increased profits to the stockholders.

Not the least important of the developments of the last three years has been the financial development. The fine showings as to earnings, the gradual decrease in operating expenses, where increases were expected, the

oft-demonstrated ability to run electric cars in all kinds of weather, in ice, snow, sleet, hail or rain, has greatly improved the standing of electrical securities. An electric road is no longer an experiment, it is a paying investment, and there are not a few instances where the introduction of electricity has been the salvation of a horse road that otherwise would have soon been in the hands of a receiver. The rapidly increasing demand for electrical securities is an evidence of a healthy growth of public sentiment in this direction. To equip electrically means the expenditure of money which must come from an increase of the bonds of stock issued. The ability of the public to rapidly absorb these new bonds of stocks must be the ultimate limit of the ability of the railway companies to move in this direction.

In August the West End Street Railway Company put out four millions of common stock for additional electrical equipment under a plan of subscription which provided for two deferred payments. When the subscription books were closed on the 5th of August, 33,000 shares had been paid in and only a paltry 245 shares had taken advantage of the option for deferred payments. I know of no more striking object lesson than this, except perhaps the rapid rise of the West End common stock from 63 to 77, which immediately followed.

Electric securities have heretofore been offered at tempting figures, but the day for this is passing. The public are realizing that a good street railway security is better than a western railroad bond or stock, and the electric roads are better than the horse roads. Electric railways will pay where no one would dream of building a horse road, and when the public taste is whetted for electrical securities, we shall see a marvelous increase in the number of roads and the equipment of existing roads, that will mean transportation facilities for thousands who

are now unprovided, and many years' work for our electrical factories.

DISCUSSION.

MR. T. CARPENTER SMITH: I wish to suggest to Captain Griffin that while he has given us a very early allusion to an electric railroad system, yet in Providence, last year, we were reminded of the much greater antiquity of the incandescent lamp, for Moses discovered on Mount Sinai an incandescent vegetable conductor which was not consumed, and we have, still earlier than that, the fact that Noah had an ark light on Mount Ararat. (Laughter.)

THE PRESIDENT: This paper is before you for discussion; are there any remarks?

MR. HAMMER: This is an admirable paper, and contains a number of chronological events which deserve to go on record, but I think some have been omitted. To say nothing of the experiments of Dr. Siemens, whose railroad is still running in Berlin, and which dates away beyond any that Captain Griffin has referred to, I might refer to the experiments made in 1881, in Paris, at the time of the Electrical Exposition. I believe the date given as the earliest, in this paper, was 1883. I have a very vivid recollection of an electric railroad which was in operation in 1880 and 1881, a mile and a half in length, at Menlo Park, and which attained a speed of no less than 40 miles per hour, and within a very short time after that was extended to three and a half miles in length. It was such an elaborate experiment at that time, and of such great commercial value, that I think the fact should be put on record in connection with a paper of the importance that this has.

MR. GRIFFIN: I would like to say, with reference to the early experiments that I have referred to, that I

did not intend that the list should be taken as complete. Perhaps I did not express it explicitly, but I intended to confine it simply to the United States. The car I refer to on the Cleveland road—I intended to make that explicit—was the first car I know of that was in operation upon any existing street railway on the streets of a city, as an existing road. There were lots of experimental roads built, in addition to those which I have mentioned, which were built for the purpose of demonstrating the feasibility and the possibility of operating street railways by electricity; but I think that that car in Cleveland was the first car that was put into regular operation upon an existing street railway upon the streets of a city, and put in schedule operation. That may be a small distinction, but, such as it is, it is one which Mr. Bentley and Mr. Knight have always delighted to make a great deal of.

MR. ARMSTRONG: I believe that at the present time I represent a corporation, and, possibly, the only one that is a member of this Association, that operates a street railroad by electricity. While I am president of the Camden Lighting and Heating Company, I am also the accredited representative of the Camden Horse Railroad Company, which operates one of its lines by electricity, and our Camden Lighting and Heating Company furnishes the power for that operation.

I have been very much interested in this paper by Captain Griffin, and I could not help recalling the first time I saw Captain Griffin. We were just then thinking about putting in, or had contracted to put in an electrical system, and I was, with the president of our horse railroad company and some other friends, at Washington. We had gone down there to help inaugurate a President. We were riding on the top deck of one of those double deck cars, and were trying to show how much we knew about electricity. There was a large,

fine looking man standing around there who did not seem to know very much about it, or, at least, he didn't have very much to say until we got stumped, and then he came to our assistance and the more he talked the more we found he knew about this subject. When he finished he handed us his card, and we then found that we were talking with a man who was most deeply interested in this subject, and who knew the most about it. Ever since that time, Captain Griffin's name has been associated with street railways in my mind and in that of many others in their recollections of him. I want to say, so far as the experience that we have had is concerned, that the very fact of operating our lines by electricity has brought us large additional travel. Not because we make better time (because we run on the same schedules as we did with horses), not that our cars are any more comfortable, but, seemingly, from the very fact that there is a motive power there which requires the expenditure of no life whatever. There is no drawing on that thing that we cannot understand, and never will be able to understand, either in man or beast; there is no draft made upon the eternal principle of life there, but, by some intangible force, we are pushed along. The people do not find that they go any faster, and there is no more comfort in it, except the satisfaction of knowing that your comfort and your ease are not purchased at the cost of the discomfort or the dissatisfaction of anything else that lives. I had a letter last night from our street car company which said that Monday (Labor Day) was the largest day they had ever had, and that the receipts were beyond everything they had ever had before. They did not have one moment's delay; nothing was out of order in the station or cars, and in carrying these heavy loads—carrying more than they had ever in their history carried before—they

moved along very easily and very satisfactorily. As to accidents, I may say that on our electric road we have had but one fatal accident. We were drawing a trail car with a motor car and there were six young fellows coming over to some sort of a picnic and they got into the motor car, which was closed, but afterwards, while the car was in motion, going up the street, they thought they would like to get into the trail car, so they swung from the platform of the motor car to that of the trail car. Five of them passed safely, but the sixth caught his foot, and was thrown under the wheels of the trail car before the brakes could be applied, and was almost instantly killed. This same letter that I have just received tells about an accident, on the very street on which I live, by one of our horse cars to the son of a friend of mine. He was riding on a bicycle along the track, and in some way he was thrown beneath the wheels of the street car and before the brake could be applied he was killed in the same manner; so that of the two fatal accidents we have had for years on our road, one happened by the trail car, where the motor power was electricity, and the other by horse power, and neither of them could, by any manner of reasoning, be attributed to the use of electricity.

We have had no difficulty, so far as the wires are concerned, in the shape of accidents. We have got along very satisfactorily.

There is one thing with which I am not yet able to agree in Captain Griffin's paper—possibly later experience may lead me to agree with this statement—that it will pay to put down an electric road where a horse road would not pay. So far as my observation is concerned, I cannot bear out that statement, because you can surely operate a horse railroad at less expense, by running fewer cars, than you can possibly operate an electric road

where you have to have your steam plant and your power for producing electricity all the time ready. If you are operating on a fifteen minute or half hour schedule on street cars, you do not have to do that thing to the same extent. In that respect, I cannot go so far as he does in his paper. But under given conditions, where the travel can reasonably be kept at a fair schedule, that may be, and perhaps is true. Our experience is that it pays us only because we carry more people than we did when we were operating by horse power.

DR. BELL: I had occasion last year to look into this very question with a good deal of care, and in answer to my inquiries I received replies from considerably over one hundred roads with reference to the effect of a change of motive power on the traffic, and on the actual operating expenses. The result of the experiences detailed in these replies (and they were from representatives of all the well known systems) was singularly uniform in the statement that there had been a great increase in traffic, varying from 20 per cent. to 300 per cent., following the change from horses to electricity; and that whereas the actual expenses (although formerly greater with electricity than with horses) were much less, in proportion to the traffic, with electricity than with horses; and that, furthermore, very frequently a real decrease in the running expenses was observed. I think there are certain classes of roads which are operated every day by electricity that could never be profitably operated by horses, and those are roads on grades far too severe for successful regular operation with horses and which, at the same time, run through regions too sparsely settled to permit of surmounting grades by cables. There is a very considerable field of that kind which cannot be operated except by electricity. We are now operating in many places ten to twelve per cent.

grades, and operating under circumstances where it would be almost impossible to handle the cars by any amount of horse power that you could get on the street. It is in these special cases that the advantages are most manifest, although I think that to-day's experience shows that, in a system of anything like a decent size, the actual running expenses per car mile are quite a little less with electricity than with horses. Of course, on the great West End system that is very marked indeed, for that location is specially favorable. But the balance is, I think, in at least one-half the cases that I have been able to get information about, in favor of electricity in the line of expense—the total expense per car mile—quite aside from the question of increased travel.

ELECTRICAL CENSUS STATISTICS.

THE PRESIDENT: If there is no further discussion on the paper just read we will proceed with the programme. Before taking up the next thing in regular order, I will read the following telegram with reference to the census statistics which are being gathered with reference to the applications of the science which we represent here:

"MR. ALLAN R. FOOTE: All investigations in charge of expert special agents have been postponed until after the meeting of Congress. All agents have been dropped, including yourself. Letter by mail."

(Signed) ROBERT P. PORTER,

Superintendent of Census.

DR. MASON: I was not expecting to be called upon at this moment to bring this matter before the Association. It is a very important matter. You will remember that a year ago in our meetings resolutions were introduced pursuant to the report of the Committee on Legislation. These resolutions urged Congress to make an appropriation of $50,000 to enable a thorough census of the electrical industry to be taken. A bill had been introduced in Congress having this object in view, but at the last moment, in the pressure of business, the matter was passed over, and no appropriation has ever been made for taking a census of the electrical industries. Some $15,000, which has been already expended, has been taken from other appropriations by Superintendent Porter. Now Mr. Porter has found himself

obliged to take the action stated in this telegram and followed by the letter, which perhaps it is not necessary that I should read to you further than to say that, in view of the facts in the case, he states that it does not seem practicable for him to continue furnishing the funds as he has been doing without a special appropriation. In this letter he looks to the resuming of the work on the part of Mr. Foote when a proper appropriation shall have been secured. It seems to me of the utmost importance that at the present meeting this Association should take definite action looking to the securing of the appropriation which was asked for a year ago and which should have been granted at the session of Congress then being held. Personally I feel that Congress has been guilty of an absurdity. Look at the statistics which have been brought before this Association in the last hour relative to the application of electricity as a motive power in matters of traction. Look at what has been done in a score of industries. And shall no statistics be gathered, no record be made in the Eleventh Census of the development all along the various branches of applied electricity. It is now actually proposed that this work shall stop; that the census of 1890 shall make no mention of electricity. It seems to me that if properly presented to Congress at its next meeting, prompt action may be had. But in the meantime what shall be done? In the meantime fifteen thousand dollars have been already expended and yet the work falls to the ground unless it is carried directly forward now. I doubt whether it can be laid down and taken up again. It should go on now, and if the Commissioner of Census has no means at his disposal, then some special provision should be made by the Secretary of the Interior which will enable this work to go right on from to-day. There is no propriety in having any

hiatus. Feeling as I do upon this point, and feeling that we should stand before the world in a most unenviable light if this matter were dropped, I beg to offer the following:

" *Whereas*, the Hon. Robert P. Porter, Superintendent of the Eleventh Census, has authorized the collection of the statistics of the electrical industries, and has appointed Mr. Allan R. Foote Special Expert Agent for that purpose, and,

" *Whereas*, Mr. Foote has prepared schedules for the collection of such statistics, covering nearly every known practical use of electrical energy, and,

" *Whereas*, these schedules provide for information of great public value that is imperatively demanded for the intelligent discussion and settlement of questions of grave public importance, and

" *Whereas*, this Association is advised that the work undertaken is in danger of being delayed, if not altogether abandoned, by reason of insufficient appropriation, thus utterly wasting the $12,000 or $15,000 already expended, and, what is of far more serious moment, depriving the people of the benefits to be derived from a report that there is reason to believe would be a thorough and reliable authority on the subjects of which it treats;

" *Therefore, be it Resolved:*

" 1. That this Association respectfully requests the Hon. Robert P. Porter, Superintendent of Census, or, if he is not sufficiently empowered, the Hon. John W. Noble, Secretary of the Interior, to provide for the carrying to the earliest possible completion the work so well begun.

" 2. That immediately upon the convening of the Fifty-second Congress the Executive Committee of this Association be directed to secure the re-introduction of Senate Bill No. 4,329 of the Fifty-first Congress, appro-

priating $50,000 for the special work under Mr. Foote's direction and to use all proper means to secure its passage at the earliest possible date.

"3. That this Association hereby expresses its approval and high appreciation of the work Mr. Foote has done in his official capacity as special agent of the Eleventh Census for the collection of the statistics of electrical industries, and its belief that the reports that he may prepare, if enabled fully to carry out his plans therefor, as shown by the schedules submitted by him for examination, will have a value equal to that of the most valuable reports ever issued by the United States Government.

"4. That the President and Secretary of this Association be directed to at once forward a certified copy of these preambles and resolutions to the Hon. John W. Noble, Secretary of the Interior, Hon. Robert P. Porter, Superintendent of Census, and Allen R. Foote, special agent for the Eleventh Census, at Washington, D. C."

DR. MASON: I desire to say in addition that I hold in my hand a gathering together of the various schedules which Mr. Foote has prepared in his foundation work for the gathering of the information needed with regard to matters connected with electricity; and I have examined them with a great deal of care. I do not consider myself competent to pass judgment upon them, but I will say this, as one who has had something to do with statistics, that it is the most complete of any that I have ever seen. I have examined the census of 1880 with the greatest care, and I know of no department of the census of 1880 that in its foundation work will compare with Mr. Foote's work, as represented by the schedules in this book. I will go further and say of my own personal knowledge that the ablest men and the ablest judges in our country on this subject—such men, for instance, as

are at the head of our great telephonic and telegraphic interests, hold the same opinion that I have expressed, and look forward with profound interest to the completion of this work. We of the National Electric Light Association are not the only ones interested, but all the interests into which electricity enters and is entering as a factor are interested in this question. I hope that this matter will not end with this Association, but that at the convention of the Street Railway Association similar resolutions may be passed, and that action may be taken by all other associations who are interested in kindred matters. I now offer the resolutions which I have read.

MR. ARMSTRONG: I gladly second those resolutions, but I think we ought to go further than that. I particularly appreciate what Dr. Mason has referred to, as to our stopping the work that has now been begun. A delay of six months is a most serious thing for us. Why? Because we are trying to gain information which will enable us to make great strides in advance in the next six months. That is the reason why we have been having conventions twice a year. I apprehend that the reason why this work is permitted to lag is largely because it is not understood. I feel that the matter is of sufficient importance to make it advisable to have a committee, headed by such men as Dr. Mason, to go to Washington. Our resolutions may go to Washington, but do you know, in the pressure of business, what is done with resolutions that are received there? What did you formerly do with them? The importance of this matter is not understood. It is not a toy that we are playing with; but how many there are who regard the whole electrical industry as merely a toy. They do not understand it; they do not use it. But those who come in contact with it and who know what a business it has become can appreciate it. As Dr. Mason has said, since the last census was made,

in 1880, a new thing has come into commercial use—absolutely a new thing, but of wonderful importance. There are very few, if any, more important industries in this country than those connected with electricity. The interest which we represent comprises only one department of the science, if I may so term it. Let us send from this body to Washington a committee, and if we have done nothing else at this Convention, if we send that committee and it succeeds in having the work continued now (and that it can be continued, if the powers favor it being continued until the meeting of Congress, we all know), if we accomplish nothing else in this Convention but that, it will well have repaid us for coming here. I trust that Dr. Mason will add to his resolutions that a committee of three or five persons be appointed by this body to present the resolutions, and that they go to Washington and at once present them to the Superintendent of the Census, to the Secretary of the Interior, and, if it be necessary, to the President himself, in order that directions may be given for the continuance of this work. There is enough of interest in the work for us, there is enough involved in it for us as an Association to assume all the expense, and to take all the time necessary to be expended, and to make all efforts that may be required, to accomplish this work and prevent its being dropped for a month or for a week. (Applause.)

MR. FRANCISCO: I fully agree with Judge Armstrong in the position which he has taken with regard to this question. I have had occasion during the past year, in a matter which I have had in hand regarding statistics, to draw heavily upon the census department, and have received very valuable information which has been gathered as has been illustrated here. I hope and trust that this matter will be pushed vigorously, and that, as Judge Armstrong says, this Association will take it up

and carry it forward immediately. Let us not be content with merely sending these resolutions to Washington. Resolutions are not apt to be acted upon promptly. When they get to Washington they are hastily read, chucked under the table, and the colored boy picks them up and thrusts them into the waste basket. I have been there, and have presented some myself, and I know how it works. I would offer, as an amendment to Dr. Mason's resolution, that the President appoint a committee, as Judge Armstrong suggests, and that Dr. Mason be made chairman of that committee. (Applause.)

Dr. Mason: It is evidently the sense of the meeting that something of this sort should be offered, and now, if you will allow me, I will move that a committee of five members of this Association be appointed, whose duty it shall be to carry the resolutions to Washington. As I have made an offer of some resolutions, perhaps I had better wait, and then, after they have been adopted, I will offer such a motion as I have indicated.

The President: This preamble and resolutions, as presented by Dr. Mason, are now before you. What is your pleasure?

Mr. Armstrong: I ask that these resolutions be adopted by a rising vote.

(The resolutions were unanimously adopted.)

Dr. Mason: I will now introduce the motion that I had in mind:

That a committee of five members of the National Electric Light Association be appointed, who shall carry to Washington the preamble and resolutions just adopted, present the same to the Honorable the Superintendent of Census, the Honorable, the Secretary of the Interior, and, if desirable, to the President of the United States, and urge the necessity of continuing,

without a day's delay, the work of Special Agent Foote.

MR. FRANCISCO: I second the motion.

THE PRESIDENT: I would suggest that a committee of three would answer as well, could present the resolutions as forcibly, and would have as much weight in presenting them as would a committee of five.

MR. ARMSTRONG: If we have a committee of five, it may be that but three will attend. In my experience, five would be better than three. I hope that all five will go.

(The resolution was unanimously adopted.)

MR. SCOTT: May I say that I know that circulars with regard to statistics have been received by electric light companies, some of whom did not think they were called upon to give the statistics called for. They did not feel that the letter compelled them to do it, and they feared that some of the statistics might be made use of in an illegitimate way. Therefore, there was some hesitation about giving the information. Would it not be wise for this Association to issue a circular to every electric light company in the country, saying that the statistics were asked for from every electric light company in the country, that the matter was important, and that the information sought was useful to all the industry, and urging every one to make prompt replies? I speak now from experience and observation of the difficulties in the way of getting this information. I would like some one to make a motion to that effect. It strikes me also that it would be a good plan to bring inducements to bear upon our representatives. If the Secretary of the Interior had $50,000 now to appropriate to this work, that would end the matter so far as we are concerned, if we can get him to do it; but I feel that if we wait for Congress to make the appropriation we may have to wait forever. I believe that every State should take up

the matter and ask their representatives to present this matter and support it in Congress when the proper time comes. If this be done, the money will be appropriated; otherwise it may not be. I think it would be a very good plan for the different companies of the State to take it up and issue a letter from each company to the local representative in Congress. I think that plan would carry great weight.

THE PRESIDENT: Do you offer that as a motion or as a suggestion.

MR. SCOTT: I make it as a suggestion. If any one thinks well of it, he may make the motion.

MR. ARMSTRONG: Would not that be a good thing to do after the committee have surveyed the ground and have found out just at what point they desire to have pressure applied, and then secure the action of members of Congress to push the matter forward. I think the suggestion is a most excellent one, and, if acted upon in that way, would aid in securing what we all desire.

THE PRESIDENT: I would state in reply to a suggestion as to the difficulty in collecting the statistics, that Mr. Foote has had a special agent go to as many cities and towns as he has had time to reach, and personally interview the central station men and get his information, which, at a later date, is to be incorporated in the records.

DR. MASON: May I be permitted to present another resolution which ought to come up now for action in connection with just what has been done?

Resolved, That the Association request the co-operation of other electrical associations and societies, also all associations or societies directly or indirectly interested in this subject, in measures to secure the carrying to completion of the census work commenced by Special

Agent Allan R. Foote, for the collection of statistics of the electrical industries.

Mr. Francisco: I second that resolution.

(The resolution was unanimously adopted.)

The President appointed upon the committee to visit Washington and present to the proper government officials the resolutions on the electrical department of the Eleventh Census the following members:

Dr. A. F. Mason, Chairman.
Marsden J. Perry.
M. J. Francisco.
A. J. De Camp.
Hon. E. A. Armstrong.

DISCUSSION ON SAFE WIRING.

THE PRESIDENT: On Monday the Committee on Safe Wiring made their report, which was received and ordered printed, and the matter was to be taken up at the earliest moment after the copies were received for distribution. The copies are here, and the matter now properly comes up for discussion.

DR. MASON: In order to facilitate business, I want to call attention to the last words in the recommendation attached to the report of the Committee on Safe Wiring, for I prefer to call the committee by that name. I call your attention to the resolution which was offered by the committee:

"That a committee of five be appointed by the President, to be a permanent committee on safe methods of construction and operation; any vacancy that may occur on the committee, from time to time, to be filled by the President."

I move the adoption of that resolution. If the motion is seconded, I wish to make some remarks.

MR. ARMSTRONG: I second the motion.

DR. MASON: I have made this motion at the initial stage of the consideration of this report for the reason that, whatever we may do with this report, we need such a committee; and, in the second place, because there has been a great deal of honest and earnest work done by this committee, and we cannot but appreciate its value. But, at the same time, neither this committee, nor any committee, has presented to us a full report on this matter, with rules which would be satisfactory to all

of us, and probably they could not be presented until we had obtained the sanction of a majority of the Association to them in every particular. There are certain things about this report which seem to me—if I may be allowed in that way to criticise it—to be absolutely absurd; as, for instance, when the committee commence with the statement that they have "formulated certain preliminary requirements which they think essential to safe wiring," and then say, "these must not be considered as rules to be absolutely followed." Now, gentlemen, if we are to have rules that are absolutely essential to safe wiring, but which are not to be absolutely followed, why, then, let us stop the work. I think that we ought to have adopted by this Association certain rules which shall govern, so far as we can control the future, all installations, or, rather, all installations in the future, and control them absolutely. If, with the co-operation of all the insurance men and of all the electrical engineers, and the expression of the wisdom of our own members, we cannot make such rules, then we ought to be ashamed of ourselves. I do not think we should adopt anything which we do not consider should be absolutely followed, but what we say should rather be in the nature of suggestions as to the line upon which each local association may form its own rules in detail, independently. Let us makes rules, and let us make rules to be followed, and let us ask that they shall be followed. So much for that.

Now, most of these rules will probably be acceptable and accepted by every member of this Association in just the form in which they have been presented; others of them will not be so accepted. At least, I know that I should question the expediency of some of them. When they shall be taken up *seriatim* I shall express my feelings in regard to them. I desire, if that resolution

shall be adopted, to have this matter taken up point after point, as rapidly as may be done, in order that suggestions may be made and discussed, and in order that we may adopt what we can, and then refer to this new committee all those as to which we entertain doubts; let them consider them for another six months and come in at the next meeting and present them to us. Most of these rules we can adopt without question; we can leave the rest of them in the hands of this new committee.

MR. NICHOLLS: I quite agree with the desire expressed by Dr. Mason, to have the Association adopt a code of rules; but will it not be necessary, before we can adopt and enforce those rules, to have the insurance authorities agree with us as to the rules in detail?

MR. FRANCISCO: I will simply say, with regard to this insurance business, that I am a member of the insurance fraternity of the United States, and from the knowledge that I have I am able to state that 15 States have already practically adopted these rules as they appear here, and that the New England Insurance Exchange will adopt them. I advocate the adoption of these rules just in the form that this committee has reported them. We appointed a committee who have spent a great deal of time in investigating the subject. That committee is composed of the ablest men we have in the Association in respect to the subject upon which they have been working. They are men who have had practical experience in this business, and who understand just what is required. They have gone over this entire field. Of course, they have taken up all of these points, have investigated them, and have consulted with insurance companies and with the insurance associations of the different states with regard to all these different points. Now, if you undertake to cut these rules up and to change them, you will at once get into trouble with the insurance

associations. The Insurance Association of the Northwest practically adopted these rules. If you now change these rules, of course you will bring a conflicting element into all these associations—in the Northwest, in the Southwest and in the New England States as well. I trust that this Association will adopt these rules just as they stand. If there is any little point that the members do not agree to, or think they cannot comply with, still, let them adopt these rules, test them, and at some future time that matter may come up and be further considered. But when you have such a man as Captain Brophy (who has been on the road examining electric light plants for years) on a committee of this kind, and he has devoted his time and contrbuted his experience in devising these rules, you may depend upon it that you have got something that you can stand by.

MR. ARMSTRONG: I would like to enquire of Dr. Mason, of Mr. Francisco, or of Captain Brophy, whether it would not be possible to go a little further than the committee has done here in this resolution, and to have this whole matter placed in their charge? I understand that Dr. Mason is entirely satisfied with the general scheme. Let us, therefore, adopt it as a general scheme, just as the matter now stands, because if the notions of each member of the Convention are to be applied to each one of these rules, we shall not have time to do anything else during this Convention. It seems to me, if it be possible, it is best to adopt this just as it stands, and then give power to this committee (and which power, I suppose, would be given by the resolution appointing the committee) to make such changes as Dr. Mason, or anyone else, can convince the committee are necessary. It seems to me that, in respect to a scheme of this kind, the committee can determine doubtful points better than the Convention itself could determine them; so

that I think it would be better to have the whole matter go back to the committee, provided, of course, the general scheme, as it stands, is satisfactory, and I apprehend that this is the case.

Dr. Mason: I think that I have failed to make myself understood. The motion which I have made is simply to adopt a certain resolution; but if you will allow me, I will answer these points now, in order to make it clear.

My point was exactly that which Judge Armstrong presents. I say, let us adopt absolutely what we can, and deny nothing, but simply refer to the new committee matters in respect to which we are in doubt, in order that they may do just what we have said. Now, it is of no use for us to consider what the insurance men might say, for we know more than they do about certain things. I say "we," for I am as largely interested as any of you in electric light and power plants. No matter what the insurance men may say, we do not wish to adopt rules which we do not approve. We settled it a year ago that we would do this thing independently, after securing, as far as we might, all the wisdom that there was in them. I want you to understand, Mr. President, that I desire to have the majority of these rules adopted and made absolute—not adopted tentatively, but absolutely; and that everything on which we have serious doubt be referred back to the committee for their further consideration. I believe that Captain Brophy and every other member of the committee, if they will give me five minutes, will be convinced that they have made grave mistakes in respect to some of these rules. I call for the question on the adoption of that resolution.

Mr. Francisco: I wish simply to say, in reply to Dr. Mason's statement that he does not care a fig for the

insurance companies, that, nevertheless, when he says that he don't care a fig for the insurance companies of the United States, or of England—

DR. MASON: I did not say anything about that.

MR. FRANCISCO: It stands just here with regard to the insurance companies: The insurance companies insist upon certain conditions. If you don't comply with what they consider essential conditions, you will get into trouble. Now, the insurance people have conferred with this committee, and they have practically approved these rules. By adopting them, you not only secure the adoption by these insurance associations of your own committee's rules, but you make a harmonious thing through the whole field.

MR. ARMSTRONG: May I rise to what is hardly a question for information, nor a point of order; but Dr. Mason has made the point here that these rules are not to be absolutely followed, but are really tentative rules. I want to be informed by the committee whether, if we adopt these rules, we make them absolute rules, or make them rules which we may use, or not, just as we please?

THE PRESIDENT: I thought you were going to raise a point of order. The question before the house is on the adoption of the resolution recommended by the committee, that a Committee of Five be appointed for future action relative to the safety of wires. That motion has nothing whatever to do, as I understand it, with the adoption of these rules by this Association. We have received the report of that committee, but we are making no disposition of the report of the committee as yet, as I understand the question.

MR. ARMSTRONG: I understand that a point of order may be raised, but it seems to me that this resolution is broad enough to let the whole scope and scheme of the committee come in for discussion under it; because, if

we do not want the scheme, we do not want the committee.

THE PRESIDENT: We want a new committee for future work; but as to the adoption of these rules, that is something that will come before the Convention after the pending resolution is disposed of. It seems to me that that is the proper line and direction in which we are to try to work. Are there any further remarks on the question of the adoption of the resolution providing for the appointment of a committee?

(The resolution was adopted.)

THE PRESIDENT: Now you have before you, as I understand it, the report of the Committee on Rules for Safe Wiring, and it is for you to signify your pleasure in the matter. It seems to me that, while we all have confidence in our committee, still, I do not think there are any of us who want to adopt these rules without first having an opportunity to go through them in detail. As suggested by Dr. Mason, it will take a good deal of time to go through them in detail in this Convention; but I can see no harm in receiving the report, permitting the thing to stand as it is, and making it a special order of business for the next meeting of the Association.

MR. ARMSTRONG: Is it at all necessary, under the resolution that we have already adopted, to do anything at all? We have appointed a committee, which committee is to be the arbiter of rules for safe wiring. I take it that it would be a waste of time for us even to attempt to adopt these rules, and I am sure it would not be a mark of wisdom for a popular convention, such as this is, to undertake to adopt these rules. We have now resolved to appoint a committee, which will be a permanent committee, on safe methods of construction and operation. Within a year, these rules, in many essential points, may be absolutely changed. I know that in our

station we have had to throw out things which, a while ago, were recommended as important or essential; and the things now adopted may soon have to be changed for something else. So, while these rules may stand as suggestions coming from the committee, it would be inadvisable to adopt any of them absolutely.

DR. MASON: If we do not do something—what do we do? We throw this matter into the hands of other people. There are rules here which I declare to you are absolutely absurd, and I cannot understand how they could have passed this committee. What are we to do with them? Are we to leave ourselves to be bound by rules which we cannot approve? In what position, as members of the National Electric Light Association, do we stand?

MR. ARMSTRONG: I move that we resolve ourselves into a Committee of the Whole upon this matter, so as to dispose of it speedily and without taking time to make a record of what is done, except to report as a Committee of the Whole, and then we can dispose of the whole matter.

DR. MASON: I second the motion.

(The motion was agreed to and the Convention went into a Committee of the Whole, for the consideration of the report of the Committee.)

(Mr. Francisco was called to the Chair.)

DR. MASON: I move that the preamble of this report be struck out as not expressing the views of this Association. The preamble is all that precedes the word "Class."

CAPTAIN BROPHY: I second the motion. A word of explanation is, perhaps, proper here. Your committee were appointed, not knowing much what they were going to do. That preamble, perhaps, does not satisfy my view. I believe that this Association is the

one from which rules should emanate. Insurance companies are ready to adopt anything that practical men of the business suggest. They appoint men as inspectors, often, who have no experience whatever, and some of them, perhaps to make themselves a little more important in the eyes of their employers, assume to adopt rules, and we are flooded now with a lot of trash all over the country. I believe that this Association should make the rules, and I know that the insurance associations will adopt them. (Applause.)

(The motion to strike out the preamble was carried.)

CAPTAIN BROPHY: To facilitate business, I suggest that the sections that are open to criticism be taken up, and the committee be allowed to make any suggestion they see fit.

DR. MASON: I move that the Chair or the Secretary call the numbers under the different headings and that, unless objections be made, they be regarded as adopted.

(The motion was carried.)

The Chairman read the rules under the headings, "Generators or Motors Must be," "Care and Attendance," and "Switchboards Must be."

DR. MASON: There is evidently a typographical error. I think it should be, "Equipped with Bars and Wires, in accordance with Rules 1, 2, 3, 4, 5, 6 and 7 for placing interior conductors." Am I right? The committee say so.

THE CHAIRMAN: Then we will consider that it be made to read, "For placing interior conductors."

The Chairman then read the rules under the headings, "Resistance Boxes and Equalizers," "Class B, Arc (Series) Systems," "Overhead Conductors."

MR. ORFORD: I should like to ask a question in reference to this place where it says, "Wires for high and low potential circuits should not occupy the same

support." I should like to have it understood what is meant by "should not"—how far the insurance people are going to take up this question.

DR. MASON: They cannot control it.

MR. ORFORD: Who is going to give me advice on this subject? I want to know what is meant by that. I want to know what is the idea of the party who framed these rules.

CAPTAIN BROPHY: It is customary in many places to put electric light wires, telegraph wires, telephone wires, and all kinds of wires that you have control of, on your poles. Are you compelled to go on the same poles with them? An accident is caused and the resulting fire is laid to you—not to them. My idea is to drive them off the same side of the street, possibly.

MR. ORFORD: I move that the words "Wires for high and low potential circuits should not occupy the same supports" be struck out.

MR. AYER: In seconding that motion, I will say that my object is to get action. While I am in favor of the object to be attained by the rule, the wording of it is such that it might lead to complication.

MR. SCOTT: I do not see why that should not be retained. As I take it, from looking over this report, there are articles here stating what you shall do, articles stating what you shall not do, and articles stating what you should not do. Evidently the committee have found themselves in difficulty as to what should or should not be done. Now, with one pole having high and low potential wires, under the converter system, you might put a thousand light circuit on one pin and a sixty light circuit on the same pin on that arm, if we struck that out. I do not see that it does any harm to leave it in.

(The motion to strike out the words "Wire for high

and low potential circuits should not occupy the same support" was carried.)

The Chairman read the rules under the heading, "Interior Conductors."

MR. CUTTER: I object somewhat to the expression "moisture-proof," that is all; because I know that some of the sellers advertise conductors as moisture-proof, and it is not well enough understood what moisture-proof means. I would like to ask the committee if it would not be better to make it water-proof.

CAPTAIN BROPHY: I think we have a clause with respect to wires that pass through an insulating process.

DR. MASON: There is a wide misapprehension, as Mr. Cutter has suggested, of the distinction between moisture and water. Now, certain wires are moisture-proof; they will stay in the air, if you please, exposed to the rain. But a water-proof insulation is one that will bear immersion for an indefinite length of time under water, and still protect the copper. I think we will all agree that the insulation for the purposes mentioned in Article I should be water-proof. I move we substitute for the word "moisture," the word water.

MR. LAW: I second the motion.

DR. MASON: I wish to include in my motion the substitution of water for "moisture" in the second line on page 5.

(The motion was carried.)

DR. MASON: In paragraph 5 the lines are misplaced. The paragraph should read:

"In dry places, kept rigidly apart at least ten inches, except when covered in addition to insulation by a moisture-proof, non-conducting and non-inflammable tubing, which must be strong enough to protect the insulating covering from injury. Conductors thus placed may be run not less than three inches apart, and be fastened with

staples under which are placed mechanically rigid insulating strips."

The rest is correct. Now, Mr. President, having read this, I move you that in place of "moisture," the word water be introduced, for the reasons before mentioned. Wherever the word "moisture" occurs in this section, I move that the word water be substituted.

(The motion was carried.)

MR. BRADDELL: In clause 6 it speaks of lights in multiple series. I think that system is just a makeshift now. I move that the clause on lights in multiple series be cut out altogether.

DR. MASON: I want to raise a question; will you please to rule upon it, Mr. Chairman? This is a committee of the National Electric Light Association. I am perfectly willing, if it is so understood from the Chair, that any and all of our visiting friends should take part in the deliberations, but I would like to have a decision on that matter.

THE CHAIRMAN: I should have to rule, of course, that they had no authority, unless it was by a vote of the body.

DR. MASON: My impression is that motions are being made by persons who are not members. I am perfectly willing that it be so, if the Chair so decides.

THE CHAIRMAN: I should rule that they had no authority without the permission of the body. Unless my ruling is objected to, or overruled, of course it will stand. Anybody who objects to the ruling of the Chair can go to the house.

DR. MASON: I then say, Mr. Chairman, according to my best understanding, the motion just made was not made by a member of the Association.

The Chairman then read the rules under the subheading, "Outside Overhead Conductors Must be."

Mr. Orford: "Provided with suitable safety fuses at the junctions of distributing mains with feeding conductors." My friend, Captain Brophy, and myself never agreed on this question, and we are not going to agree about it to-day unless he will be a party to striking that out. This is for overhead wiring. Now, the feeders come back only to the station. I cannot see how it is going to protect the insurance interests to have a safety fuse at a point where the feeders are attached to the main. I move that No. 2 be struck out.

(The motion was carried.)

Captain Brophy: I wish to allude to one sentence in the gentleman's remarks—we look out for your interests fully as much as for the insurance interests in this matter.

The Chairman read the rules under the sub-headings, "Underground Conductors Must be," and "Inside Wiring."

Mr. Orford: I should like to ask for an explanation about this. At the entrance of every building there must be a double pole switch. When we get a little further on we find that a safety box should be placed there also. Have you any preference, Captain Brophy, as to where the switch should be—in front or behind the box?

Captain Brophy: I do not know as it adds anything to the safety. As I said here yesterday, it has come to be fashionable to lay any mysterious fire to the electric light wires, whether they are dead or alive. If that little device is placed there, it is a silent witness that will give the lie direct to the sensational newsmonger and the inefficient official.

The Chairman: Do you make a motion on that, Mr. Orford?

Mr. Orford: No; that is all right.

DR. MASON: "Conductors must not be laid in plaster, cement, or similar finish." I object to that. I have asked the committee their reason, and they have said that they have not as yet found any insulated conductor, the insulation of which is safe, that will last in lime, plaster or cement. I have seen where a responsible house in the last month has taken a contract to put sixty-five miles in one building in cement and plaster, and give a guarantee, the fulfillment of which, if it fails, will cost them at least one hundred thousand dollars. I believe that there is to-day an insulation—if there is not more than one—that can lie in plaster or cement for any number of years and not be injured by that contact. I object to that clause, and simply move that it be referred to the committee appointed. I do not ask to strike it out, but I ask to hold it in abeyance, awaiting the verdict of history. The wire is now being put in one building—65 miles of it—laid in cement and plaster, and in a few years from now we will know whether we can continue to do it.

MR. CUTTER: In seconding that motion, I feel that we are not ready to make such a rule absolutely. In our fire-proof buildings in Chicago, we do not know how else to put the wires for many of those circuits, and for that reason I second Dr. Mason's motion to refer this question to the committee for further consideration.

CAPTAIN BROPHY: We have been unable thus far in Boston to secure anything to fill the bill.

DR. MASON: In one building in Boston, I put in 20 miles during the last year.

CAPTAIN BROPHY: We have tried everything and all have failed.

DR. MASON: I do not assert that we can do that safely, but I do assert that it has not been proved that we cannot.

MR. ARMSTRONG: I would suggest that No. 7 be just left blank. We do not want to refer it to the committee, because it will have no proper place in the report of the Committee of the Whole when we adopt it.

DR. MASON: I move that it be referred to the Committee of Five.

MR. ARMSTRONG: I understand; but we want to strike that out entirely in our adoption of this, and the adoption of the Committee's Report. Simply as a method of procedure, I suggest that that be stricken out, letting seven stand there blank.

DR. MASON: Very good: I accept that.

THE CHAIRMAN: It is moved and seconded that all of section 7, except the number, be stricken out.

(The motion was carried.)

DR. MASON: I ask the committee to explain this eighth clause, which reads, "Conductors must not be concealed, unless easily accessible." Now, all the finer buildings, pretty much, in this country, are being wired in this way: There is a wall; the wires are put up there and the plaster is plastered right on them. They are not easily accessible.

CAPTAIN BROPHY: I think that has got in there from another system; I move that it be left blank.

THE CHAIRMAN: It is moved and seconded that all the words contained in the first and second lines of section 8, after the number, be stricken out and referred to the committee.

(The motion was carried.)

DR. MASON: Evidently, there is a mistake in the paragraph which says that "staples must never be used to fasten conductors, unless, etc." All the underwriters' representatives in the East have in writing recommended a staple which has no sleeve or saddle. I want to say that, unfortunately, I have something to do with a

staple, but any gentleman who is here, who wants it, can have all that goes with it. There is one saddle staple which is excellent, except in very wet places. This does not say metal staples; it simply says staples. I move the insertion of the word metal before the word "staples."

THE CHAIRMAN: It is moved and seconded that there be inserted before the word "staples," in the heading of the section or article, the word metal.

(The motion was carried.)

MR. SCOTT: Doesn't it destroy the effect of the second paragraph to insert the word metal in the heading?

MR. CUTTER: I want to call attention to a point not of very great importance. It reads here, "In rooms where inflammable gases may exist, or where the atmosphere is damp, the incandescent lamp and socket should be enclosed in a vapor tight globe." I move that the words "or where the atmosphere is damp," be stricken out.

DR. MASON: I second that; I should like to hear from Captain Brophy about it.

CAPTAIN BROPHY: This is intended to cover such places as oil plants, where inflammable gases are continually arising, where naphtha is used to a considerable extent. It is not intended to cover illuminating gas.

DR. MASON: I move, if Mr. Cutter will allow me, just to refer that clause to the committee.

It is moved that all of the first and third lines be stricken out.

(The motion was carried.)

DR. MASON: Now, under the next clause, I want to ask Captain Brophy if, in his opinion, a wire covered with the very best quality of rubber, and nothing else, would not be the very worst thing that could be put

there that he could conceive of; yet, that would be an absolutely water-proof covering.

Captain Brophy: I believe they have all failed.

Dr. Mason: It is true, Mr. Chairman, that an absolutely water-proof covering, that is, the best vulcanized rubber, would be the worst thing that could be put there; while there are compounds existing in the laboratory of nature—I do not say any one, but I do say that there are substances that are adequate. I think it should be referred to the committee, with the hope that they may devise a phraseology suitable to the case. I move to strike out section 2, and refer it to the committee.

Mr. Ayer: I move that the committee rise. It is now one o'clock, and we have a large amount of business to transact before we leave Montreal. Before we went into a Committee of the Whole, I tried to put the thing into shape, to have these papers circulated and discussed, and action taken on them six months hence. We have got through eight pages, and it is now one o'clock. I think the matter should be allowed to take the course first suggested.

Dr. Mason: What course is that?

Mr. Ayer: That it be referred over, and taken up six months hence.

Dr. Mason: I do not want to oppose that; but I know of no business that can come before this Convention equal in importance to this. I think this is the most important matter that has been before us during our entire history, and I do not know why it is wise not to give it all the time necessary.

Mr. Ayer: I want to say that we are not giving it the proper time. You call off Nos. 8, 9, 10, and so on, to men who have never looked at it before.

Dr. Mason: It has been their privilege to look at

it. This has been printed for days; I had it yesterday morning at ten o'clock.

MR. AYER: I never saw a copy of it until this morning.

DR. MASON: Mr. Chairman, you allowed me to refer to this matter of our present deliberation. I not only say that this is important, but I want to say that it is important that it should be settled immediately, because all over the country every station is bothered to death by a lot of boys, such as Captain Brophy has referred to, who know nothing, and make rules; and to-day all rules are being violated because they lack authority. If we pass some good rules here, immediately, we will work a benefit for the whole industry throughout the country and every one of us will feel it. I shall not press this, and yet, personally, I do not believe we have any business that can come before us more important than this.

MR. NICHOLLS: Is an amendment to the motion in order.

THE CHAIRMAN: No sir; and no discussion is in order.

MR. NICHOLLS: I was going to suggest that a committee of three, or four, or five, be appointed to meet to-night, go over the rest of the schedules, and report upon the clauses in which they would recommend alterations, to-morrow morning.

DR. MASON: Mr. Chairman—

THE CHAIRMAN: You are out of order—all of you.

DR. MASON: We are, sir; but will you not allow me to make a remark that will clear this? I have been through this whole thing with several gentlemen here, and I do not know of a single place from this to the end where anybody wants to make an amendment.

(The motion that the Committee of the Whole rise, was put and lost.)

DR. MASON: I am wrong about one thing; there is one thing we shall wish to correct.

MR. ORFORD: It reads, "In breweries, stables, dye-houses," etc. I move that the word "stables" in that paragraph be stricken out. We will find no great danger in stables that I know of. We have got about 20 of them. I saw the fire department trying to put out a fire in one of them. We had our lights burning all the time. If you keep stables in, you will find that we are not allowed to put a switch or a fusible cut-out in the stable.

THE CHAIRMAN: It is moved that the word "stables" in that paragraph be stricken out. If there is no objection, it will be stricken out.

DR. MASON: I move that section 2 be stricken out and referred to the committee, because that word "water-proof" is not the proper word there.

THE CHAIRMAN: If there is no objection, it will be so considered. It is stricken out.

The Chairman proceeded to read the rules under the heading, "Interior Conduits must not be."

MR. HAMMER: "Of such material or construction that the insulation of the conductor will ultimately be injured or destroyed by the elements of the composition." That does not refer to the composition of the material in which the tubing is put. I have had experience with interior conduits that have been placed in walls where the cement itself has absorbed the material used in insulating the tubing, and has left nothing but the brown paper, and there are chemical actions that go on in a good many of these walls on the insulating tubing, and the tubing should be so manufactured that the constituents of the plaster should not act chemically

upon the tubing. I think that is a very important thing, and I move that such a clause be introduced at that point.

A MEMBER: I do not understand the point.

MR. HAMMER: The point is this: There is a conduit company that is putting in some conduits and I have charge of the work. They have been placed in plaster, and the plaster has absorbed the bitumen out of the tubing, and has left the paper in almost its original state. That is not due entirely to the moisture. It is due to the chemical action of the material in the tube. My motion is that in the second clause there be introduced a section covering not only the tube itself, but the material in which the tube is placed.

DR. MASON: Let us pass on and recur to that by and by.

THE CHAIRMAN: I have not heard a second to that motion.

The Chairman proceeded with the reading of the rules.

DR. MASON: I move that instead of the word "should," in the sixth section, we put in the word must. I should also prefer to have that read water-proof material; but no matter.

(The motion to substitute must for "should" was carried.)

The Chairman proceeded with the reading of the rules.

MR. ORFORD: Where are these double-pole safety cut-outs to be placed—inside or outside of the building?

THE CHAIRMAN: Captain Brophy, perhaps, can give us some information on that subject.

CAPTAIN BROPHY: It is rarely practicable to put them outside; no one pretends to do this.

MR. ORFORD: I would mention, in connection with

that, that in Cleveland, as I understand, the underwriters insist that the switch and fuse box shall be on the outside of the building.

MR. ARMSTRONG: I move that when the committee rise it report these rules, as amended and corrected, to the Convention favorably.

(The motion was carried.)

MR. ARMSTRONG: I move that the committee now rise.

(The motion was carried.)

THE CHAIRMAN: The Committee of the Whole is now dissolved.

The Chair was taken by Mr. Ayer.

THE CHAIRMAN: The next business is the report of the Committee of the Whole.

MR. ARMSTRONG: As I understand it now, the report will be from the Committee of the Whole, that the chairman of the Committee of the Whole reports the rules amended favorably, which we then adopt; and the record that has been made about amendments is all we need.

REPORT OF THE COMMITTEE OF THE WHOLE.

Mr. Francisco: As Chairman of the Committee of the Whole I have to report that the rules were adopted favorably, as amended, and I now report them to the Convention as the rules adopted.

Dr. Mason: I move you, then, upon this report of the Committee of the Whole, that the National Electric Light Association do adopt the rules as amended.

(The motion was seconded.)

The Chairman: Gentlemen, you have heard the motion as seconded, to adopt the report of the Committee of the Whole—to adopt the rules on safe wiring as amended by them.

(The motion was carried.)

THE CHAIRMAN: Gentlemen, the next order of business will be a paper by Mr. C. J. Field, on Electric Railway Construction and Operation.

Mr. C. J. Field then read the following paper:

ELECTRIC RAILROAD CONSTRUCTION AND OPERATION AND A CONSIDERATION OF THEIR CONNECTION WITH CENTRAL STATION INTERESTS.

INTRODUCTION.

The advantages of the electric railway have passed beyond the age of experiment or question. They are proved by their development in the past four years, and any argument as to their advantage in the general development of street railway practice or suburban rapid transit is antedated. It took several years to convince old staid financiers and directors of the larger street railway properties that it was to their financial advantage to throw in the scrap heap several million dollars, more or less, in equipment and spend that amount in addition, and still make it pay; but they have seen this advantage in the development and increase of traffic and returns to their company. These returns have been brought about principally by the development of rapid transit, in the introduction of electricity and the flexibility of the system in adapting itself to all and any conditions of commercial practice.

In looking over the past four years of practice in electric railway work we have much to commend and

considerable to condemn. The boldness of the achievements, the problems that have been solved, the rapidity of development and perfection of the apparatus, seem almost beyond comprehension. That this apparatus, in less than four years, should reach the high state of perfection, economy and efficiency that it has, as compared to the long years of development of other mechanical appliances, is remarkable. The natural consequence of this large amount of work and development in this short time is that there has been much work done that had better been left undone, in the way of poor engineering, cheap work, and not a proper appreciation of the problem to be solved. These, in some poor instances, have retarded the development and progress of electric railway work in their vicinity, but street railway companies have now came to a proper appreciation of the necessity of good work well done and that the wisest and best method is to consider carefully what will bring the best return for the money invested—not necessarily on the blind basis of the highest cost being the cheapest, for money can be wasted in this way as well as others. We have examples now in several directions of large equipments being installed on a sound engineering basis and with careful consideration of the best interests of the electrical interests, street railway owners and public combined, and we can safely add that there is no problem in this line which cannot to-day be taken up with a full assurance of practical solution and successful development in electric railway traction.

The future outlook of electricity in the development of rapid transit, inter-suburban, and even express service, is assured. We are coming now to the solving of the larger problems in this work, and bringing the public to a proper appreciation of the resources and possible achievements in this line and its superiority over the old

fogy systems of the past. We even see a considerable number of our friends from cable engineering lines of street railroad work coming over into the electrical fold, fully appreciating that the cable system has a very limited field for successful development and that electric traction is very broad gauge in the field of engineering work. Therefore, with this outlook, better construction work, better engineering, better mechanics, the solving of these larger problems are assured, and we see even to-day, in a number of cases, electric suburban traffic supplanting steam on a cheaper, better and more successful basis. The favorable report of the New York Rapid Transit Commissioners has done much to add to public confidence in this direction. Electric manufacturing companies are assisting the development of the work by making their apparatus more substantial, better in construction and more satisfactory in its mechanical design and operation. The reduction in the speed of the motors, the development of single reduction, and even of direct connected motors, is doing much to add to the confidence in this line.

We hear asked sometimes, by laymen, the question: "What speed can electricity obtain in railway work?" The able consideration of this subject in several papers, and practical experiments as well, enables us to reply very briefly but confidently to this inquiry, that speed and power in electric railway traction are only limited by road-bed construction; in other words, any speed is obtainable within the range of possibility, with the maintenance of proper track. We do not intend, however, to generally review electric railway work, but more particularly to give some details of the practical problems in their construction and operation, and, therefore, we will leave the consideration of other parts of the subject to papers which will, no doubt, treat it more fully.

Steam Plant.

The consideration of the best development in the power generation of electric railway work has been one that has received considerable attention in past years from the best engineers in this line. We reach here a part of the problem which requires much more careful consideration than has been given steam power in electric lighting generally in the past. The work to be successfully done by the steam engine in the generation of electricity for the operation of railroads is the severest kind, and can be compared only to that of the engine operating rolling mill trains. It is owing to not fully appreciating this fact that we hear in some parts of the country of failures of steam plants on this kind of work. Electrical manufacturers are assisting the solution of this problem by the building of larger generators in units of 200 to 400 or 500 horse power. What we want in the generating station for electricity is the smallest division of units consistent with the safe and economical operation of the station. Following the problem out on this line, we can build a successful station; and we would add to this that each unit should be entirely independent and separate from all other units, thereby increasing the reliability. This cannot be obtained in a safe and economical way by the use of our old friend, the countershaft. Undoubtedly, the countershaft has been of much use in electric lighting service, and particularly in arc lighting; but in railway work, with large generators, we can see no excuse at the present time for its use. Generators should be belted direct to the engines, whether Corliss or high speed, or else coupled direct to the engine shaft. With a Corliss engine of 500 horse power, operating at 80 or 90 turns, with a fly-wheel 18 to 20 feet in diameter, we can belt with belt

centers of, say, 40 feet 2 inches, generators of several different commercial types; this gives us advantages which we have heretofore had only in high speed engines with direct connection. The engines should, in any event, as heretofore stated, be extra heavily built for the work to be done, with ample fly-wheel capacity. On engines of this size and speed a fly-wheel capacity of approximately 60,000 pounds is about right. On engines operating about 150 turns, say, 30,000 to 40,000 pounds.

While laying particular stress on the rapid and sudden changes of load, we do not know how to illustrate it more forcibly than in Figs. 1 and 2. Fig. 1 will show a

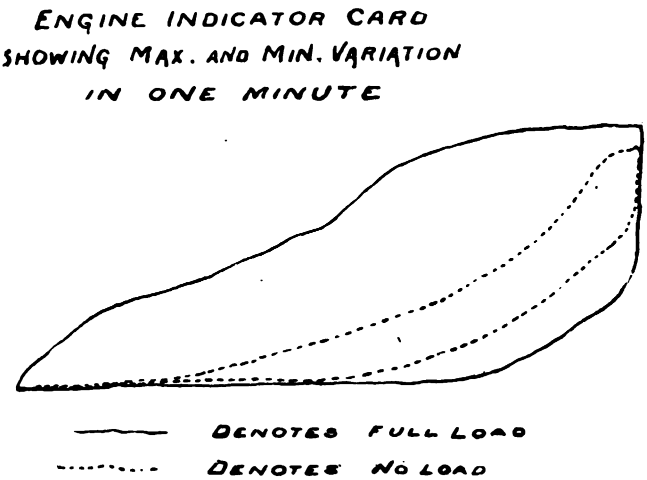


FIG. 1.

practical case of changes in the indicator diagram within one minute, placed on the cylinder of an engine running on railway work, which shows a variation within that time of from full load to no load and back again several times. Fig. 2 illustrates a load diagram from an ordinary case which has not been particularly selected for its maximum and severe conditions. These impress on the mind more forcibly than words can the requirements of

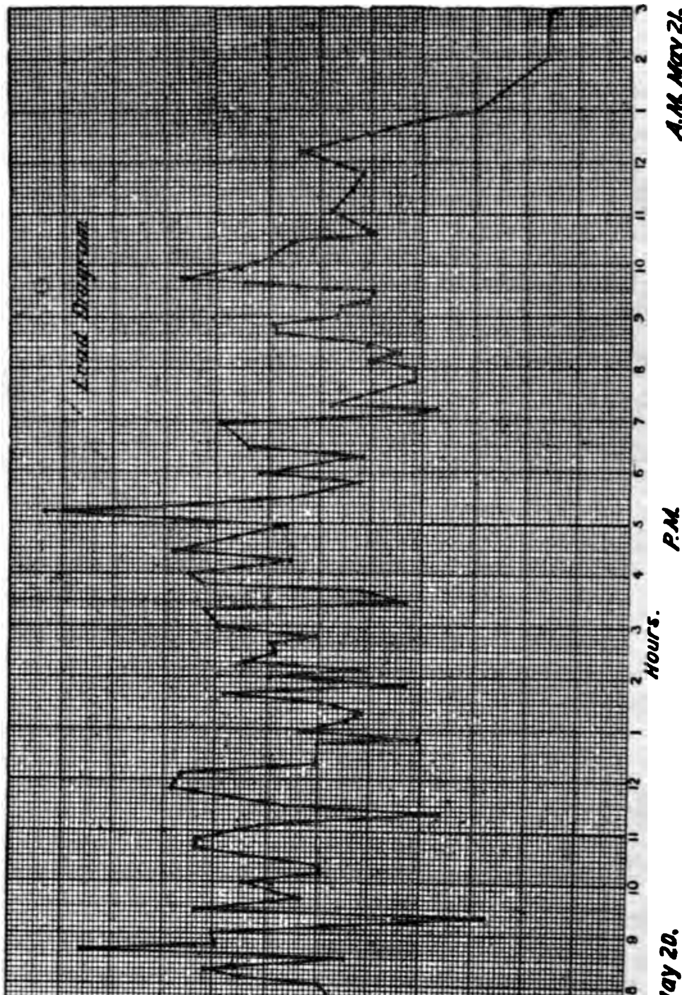
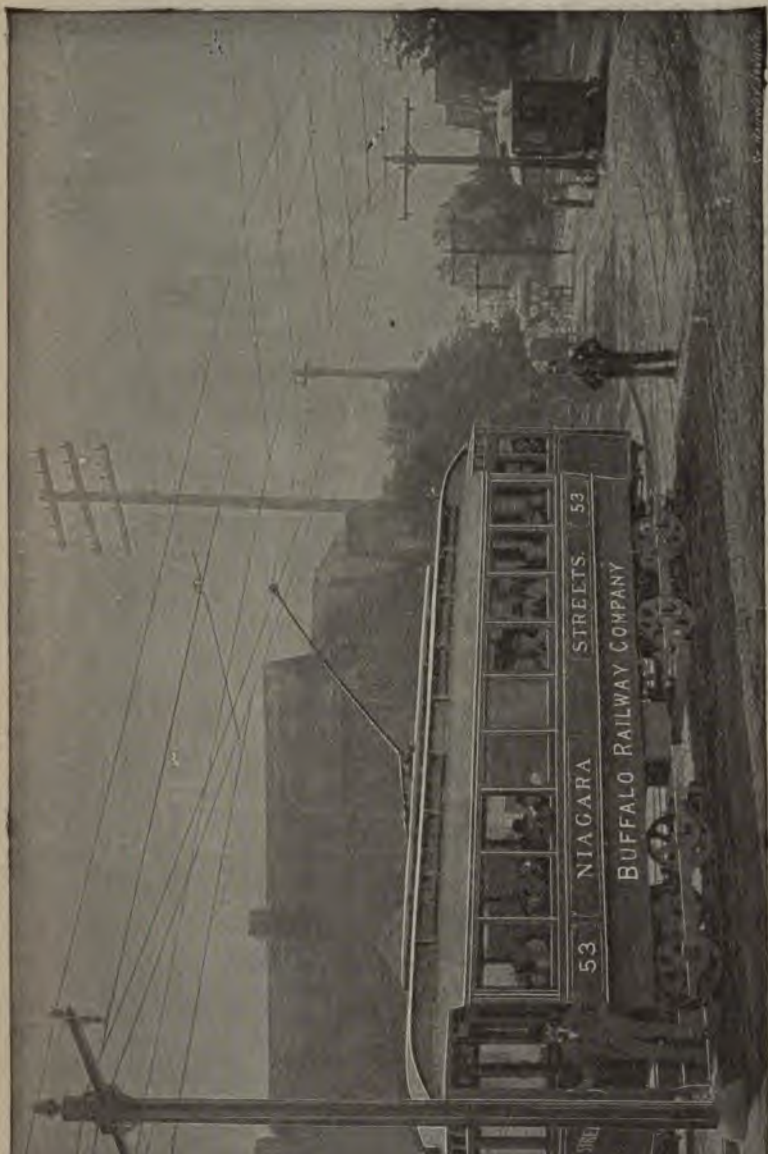


Fig. 2.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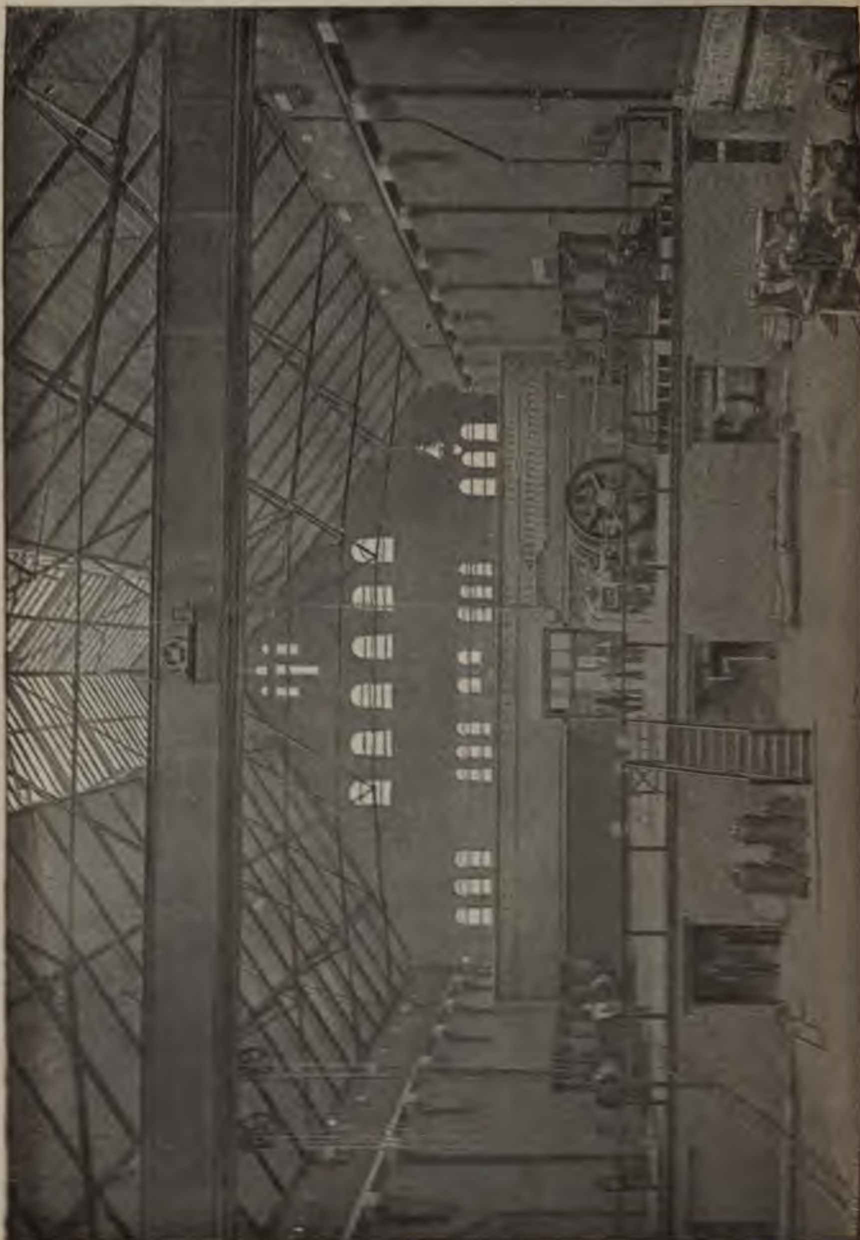

this work. High speed engines in the development of railway work have received, in some cases, a set-back owing to the engine manufacturers not appreciating fully the conditions and necessity of the work undertaken. So-called high speed or automatic engines can be as successfully operated on this class of work as any other, if they are specially built for it. This means larger parts, bearings of more ample size and length and ample fly-wheel capacity. On a cross-compound engine of, say, 300 horse power, there should be about six to eight tons in the fly-wheels, the bearings seven or eight inches in diameter and 15 or 18 inches in length. (Such a type of engine is being furnished by the manufacturers of the Ball engine.) In the case of engines built in this manner, there can be no fault found with their operation. A type of engine which, we believe, is going to be largely used on this class of work, as well as lighting work, is one that will come in between the high-speed engine and the Corliss, and which will combine many of the advantages of both. Such an engine has been sought for by many engineers and has been attempted by a number of builders. To-day, however, we cannot find it on the commercial market. This engine, in units of 500 horse power, would run at a rotative speed of about 140 or 150 revolutions and with a piston speed of about 650 to 700.

The question which has troubled most engine men in regard to the high speed engine, with a single valve, covering this kind of practice, has been a question of valves and clearances. Beyond any question, when it comes to this size, we have got to come to the Corliss practice of double valve, thereby reducing the clearances and bringing it down to the extent of the Corliss practice. The writer's company is having built for the electric railroad at Buffalo two engines of this class, by the Lake Erie Engineering Works, which we believe will do much to

develop this line of work, and, also, will be particularly adapted for coupling direct to the engine shaft. In Figs. 3 and 4 one of these engines is shown coupled to the generator. The trouble in this line has been to get electric manufacturing companies to take up the building of large multipolar generators adapted for direct coupling at a speed of from 100 to 200 revolutions. This problem was developed on a much smaller scale in this country, for marine plants, several years ago. We find that in Europe, where their work has been more special, that they have successfully developed this type of engine and generator, and, beyond any question, it is going to be, both for lighting work and for railway work, the type of unit for central station practice in the future. It means, where the vertical engine is used, the installation of steam and electric plant in the space formerly used for engines alone. This means reduction in the cost of building, operation and maintenance.

In concluding this part of our subject on steam generation, we trust that our experience in the past in lighting will show us the fallacy of poor steam engineering, and that we will build our stations for the future, and not have the problems before us that nine-tenths of the electric lighting stations have to-day, which mean that, in order to get down to commercial economy and competition, they have got to rebuild their whole outfit. We will merely append to the consideration of the steam plant part of our problem a few interesting figures and data which the writer collected for presenting to street railway companies, in order to give them some useful information in this respect. We believe that they may be well introduced here. The figures given on the tables, etc., are not figures that the manufacturer of an engine would tell you were those of the best economy for his engine or plant, but they are

figures which will be appreciated by station owners and railway companies as those which are obtained in every-day commercial tests.

The relative commercial economy of engines and cost are as follows:

TYPE.	Lbs. of Coal per Horse Power Hour.	Cost per Horse Power. Sizes Over 100 Horse Power.	
High speed single	4 to 5	$11 to $13	This is based on an evaporation of 9 lbs. of water per lb. of coal.
" " compound	3 to 3½	14 to 16	
" " " cond	2¼ to 2½		
" " " triple	1¾ to 2	18 to 22	
Corliss single	3½ to 4	16 to 18	
" compound condensing	1⅔ to 2	22 to 25	
" triple	1½ to 1⅔	27 to 30	

There are four classes of boilers:

1. Horizontal return tubular, which is the most general in use, and costs $9 to $10 per horse power.

2. Vertical tubular (Corliss or Manning), which is a vertical tubular boiler with water leg, giving an internal fire-box, economical in floor space, largely used throughout New England. Cost $10 to $12 per horse power.

3. Sectional or water tube boiler, of which Babcock & Wilcox is the best known, especially adapted for higher pressures and safety. Cost $17 to $19 per horse power.

4. Scotch type of Marine boiler—one that has not been used to any extent as yet in station work—but we believe it will be as an offset to the sectional type; and fulfilling the requirements for higher pressure and economy of space.

Capacity of engine requisite for different generators:

GENERATOR.	ENGINE.						
WATTS.	HORSE POWER.	HIGH SPEED.			CORLISS.		
		Size.	Speed.	Wt. 2 Fly-Wheels.	Size.	Speed.	Wt. 2 Fly-Wheels.
50,000	75	12 x 12	280	7,000 lbs.			
80,000	125	15 x 16	225	9,000 "			
150,000	225	18½x 18	200	15,000 "	20x36	90	25,000 lbs.
2,150,000	450				24x48	80	50,000 "

Steam pressure, 100 pounds.

The cost of steam plant complete is about \$50 to \$60 per horse power for high speed, and \$65 to \$75 per horse power for Corliss.

Electric Plant.

The question of the best electrical generating plant for railway work is one which is allied closely to that of steam plant, particularly in relation of the generators to that of the engines. In some respects, in treating of the steam plant, we have intimated what our idea was in connection with the generators. All large generators of from 200 to 500 horse power connected as directly as possible, either by direct belting or shaft coupling, with the engines operating the same. It is only by this development that the safest and best solution of electric railway station practice—in fact, station practice in general—can be reached. Manufacturers of railway generators have had an experience extending back many years. That experience in the development of direct current incandescent machinery, although not of quite the same voltage, has led the way up to the safe, economical and commercial development of railway generators; and we find the railway generator of to-day one of the most perfect and reliable factors in the electric railway system. The only problem remaining to be solved in this connection is to build them in larger types and have slower speed for direct shaft coupling. Generators on this work are subjected to the severest and most excessive strain, particularly where of small type; but the building of them in larger units is going to remove, to a great extent, the question of the overloading of the machine. Railway machines are often subjected to an overload of from 25 to 50 per cent. In general, these are only momentary, and we find most of them able to stand up to the work to be done.

The question which puzzles many of the railway companies, as well as the electric companies, is what amount of generating capacity is necessary for the operation of a given number of cars. This question, of course, has got to be carefully considered in connection with each case, but there can in a general way be laid down an approximate basis for this work. Some railway companies, in order to show a higher economy than their competitors, unwisely claim the requirement of a smaller amount of power than others; but the wisest manufacturer is the one who urges his client to install a larger amount of power than is barely required for the successful operation of the road under any and all conditions. For if any one thing will leave the public to condemn the electric railway traction, it is a lack of power, thereby causing the cars to move slowly, and in case of any accident, disabling part of the power. A fair basis on general conditions for sixteen to eighteen-foot car bodies is twenty to twenty-five horse power per car, which, with a properly designed and constructed plant, will give the desired power. The cost of generating this power for railway work for sixteen and eighteen-foot cars is three to five cents per car mile for all expenses of the generating station. In some roads we find that cars of a larger size than these do not necessarily take a proportionately larger amount of power. We find from practical experience that a car thirty-two or thirty-three feet long, double the size of the sixteen-foot car, takes, under general conditions, about 50 per cent more power, and we find by the same experience that a trail car adds about 50 per cent. to the amount of work to be done on the motor car for the same size. As to the minimum and maximum amount of power taken on an electric car, we find that a general average for a sixteen-foot car, under ordinary commercial conditions, without excessive grades, is one

horse power per car mile per hour; or, a car operating at an average of ten miles per hour means an average of ten horse power per car. This same car will give, however, on a load diagram—taking all its conditions, from maximum to minimum—a variation of from nothing to fifty, sixty or even eighty horse power. This gives us an idea of the severe strains and conditions to which an electric motor is subjected.

ELECTRIC CARS AND THEIR EQUIPMENT.

One of the questions on which we find more variety of opinion than any other is, what is the best size, type and style of car for given case and conditions? The old standard sixteen-foot car body we find is now being widely departed from, and the problem is: How large a car can we get on a single track with four wheels without excessive destructive effect on the road-bed? and, what is the longest car we can operate on street car service economically on an eight-wheel base? We believe the limit is reached with a single truck in a twenty-foot car body; we know that the truck manufacturers claim in some cases to operate a longer body, but we do not believe it wise. An eighteen or twenty-foot car, running under close headway, we believe to fulfill best the conditions of city traffic in the larger cities. Such a car, with a wheel base of seven feet, and in some cases seven feet, six inches, where curves are not too sharp, will give satisfaction, and not be too severe on the road-bed, where the same is properly constructed. As to the difference in effect on the road-bed between the electric car and the horse car, it is, briefly, that the horse car is pulled by horses, from which it receives a balancing power and a steady pull, whereas an electric car is operating itself by a power moving the wheels against the track, having no steadying or balancing power from the

pull of the horses, and transmitting all its power and moving itself through the wheels. We find, therefore, that it subjects the track to a very severe pounding, necessitating a much better construction of road-bed, practically equaling that of a steam railroad.

Some companies have favored the use of a vestibule on street cars. We believe, though, that any vestibule is a failure and a misnomer. It accomplishes no good and causes much trouble; a shield over the dashboard for the motor man in winter weather would give all that would be required. What is wanted on a street car is that which will allow the freest ingress and egress for the passengers, and anything that retards this—and a vestibule most certainly does—is a detriment and an obstacle to rapid transit. On some roads we have tried the introduction of even larger cars, say twenty-eight foot body, or thirty-six feet over all. Such a car, of course, has to be put on a double truck. These cars have found favor with some companies when first considering the problem. The difficulty with them is in getting the passengers in and out of the cars as quickly as possible, and making too many stops, due to the larger number of passengers carried. For inter-suburban heavy traffic, with a few stops, we believe such a car would fulfill the requirements, but only in such a case.

Thus, having gone over the question of the cars, we come to the consideration of the electric equipment for the same. To-day we find the double reduction motor discarded, so far as any new equipments are concerned. All the large electric manufacturing companies are placing single reduction motors on the market, and they are in successful commercial operation. One company is placing on the field a motor directly connected to the shaft and without any gearing—in other words, there is no reduction in speed, the speed of the armature being the

same as that of the wheels ; the same is accomplished by a very ingenious arrangement. We have heard asked in the past the question, Why was it necessary to place thirty horse power to operate an electric car to do the work that two horses had done formerly ? The answer is: The two horses did not do the work in a proper manner, and give rapid transit. The life of a street car horse is very short, and we find, under general conditions, that thirty horse power with two fifteen horse power motors has been found about right ; in fact, we even find the companies tending towards a larger installation of power, particularly when using larger than a sixteen-foot car body, and we find to-day, being installed for rapid transit in inter-suburban work, forty and fifty horse power electric equipments per car, many of them operating at a speed of thirty, and even forty, miles per hour. As the amount of power is directly proportionate to the speed, we can readily see the requirement for such an amount of power. The cost of a single car equipped, including the car body, truck and motors, is from $3,000 to $3,500, and the cost of the electric part of the power generating plant is from $35 to $45 per horse power.

LINE CONSTRUCTION.

We find in the past about as great a development in overhead and line construction for electric work as in any other part of the subject. While formerly this was one of the greatest sources of unreliability in the operation of the plant, to-day it has reached a very practical development. Formerly the trolley wires were too light, the feed wires were insufficient to furnish power, and the line was giving trouble, grounding and breaking continually. In the insulation of a single trolley system, with one side of the system grounded, we have the most severe requirements that it is possible to obtain in any

electric insulation, in that any grounding on the other side of the system means trouble in the operation of the road. This has led to the introduction of double and even triple insulation into our line material to properly protect the trolley wire from grounding. Where streets are wide enough to spread the tracks to six feet and six feet, six inches within the near rails, we see introduced in many places centre iron poles, which make a considerably stronger style of construction than cross-suspension. There are not many streets, however, where street cars are in operation that are wide enough, or where the city will allow the spreading of the tracks to this distance, and in closer proximity it is not safe to operate with centre poles. On the work installed by the Field Engineering Company, in Buffalo, we find the most extensive system of overhead and underground construction in operation anywhere. Here all the feed wires, with a few exceptions, are placed in underground conduits, thus removing all cause for objection to the unsightliness of a large number of feed wires overhead. These underground feed wires are connected to the overhead wires from junction boxes up the poles. Thus, in Fig. 3 is shown one of the lines on the Buffalo railway system, which gives an idea of this style of construction, as well as the use of the large cars, which are 36 feet over all.

The cost of overhead construction may be about summarized as follows :

Line construction per mile, complete, including track bonding, plain pole work, cross suspension or bracket with feed wire..................	\$2,000 to \$2,500
With sawed and painted poles........	2,500 to 3,000
Iron poles, cross suspension, concrete setting, double track, feed and guard wires...........................	6,500 to 7,500
Same with centre poles...............	4,500 to 5,500

We also append a table which will give a general summary of the cost of electric equipment of street railway systems, omitting the track construction, which, of course, varies with the number of miles to be equipped.

COST OF ELECTRIC EQUIPMENTS FOR STREET RAILROADS.

No. of Cars.	Steam Plant. H. P.	Capacity of Generators. K. W.	Steam Plant. †	Station Electrical Equipment.	Car Equipments, Car Trucks and Motors.	Line Construction ½ mile of Double Track per car.	Total Equipment (omitting track).
6	120	80	$7,000	$6,400	$19,500	$7,500	$40,400
10	225	150	11,000	10,500	32,500	12,500	66,500
15	375	240	17,500	15,000	48,750	30,000	111,250
20	450	300	22,000	17,500	65,000	40,000	144,500
30	675	450	28,000	22,000	97,500	90,000	237,500
50	1,125	750	50,000	33,000	162,500	187,500	433,000
100	2,025	1,350	90,000	60,000	325,000	375,000	850,000

The above figures are approximate only and based on the best City R. R. practice.
† Add 25 per cent. to these figures for Corliss.

TRACK.

The track of street railway companies, before the introduction of electricity, was more behind the times than any other part of their equipment. The old flat rail is antiquated and antedated, and in a few years its use will be obselete. The necessities of electric railway traction—in fact, of any traction—have impressed upon the street railway companies in their equipments the requirement of a good road-bed for the successful operation of a road, and we find this part of the problem receiving as much attention as any with companies who appreciate fully the work before them. The general construction to-day is girder rails of from 60 to 80 pounds per yard, placed on chairs where block paving is in use, with ties two and a half to three feet between centres. We find in some cases even 90 and 100 pound rails used, but we believe in more moderate weight for the rails and the ties placed closer on centres. We believe this has been the general experience in railway

work. Such a style of construction costs from $9,000 to $10,000 per mile. In suburban roads, on streets where there is no paving, we find the T rail being used; the road-bed can be properly constructed on this basis with 45 to 50 pound rail, for $6,000 to $6,500 per mile, the rail being spiked directly to the ties.

In order to make a summary of the data and figures, I will summarize them in a practical example.

AN ILLUSTRATIVE EXAMPLE.

I propose to take, as the best means of illustrating practically the purchase, equipment and operation of a street railway system with electricity, a city with a population of, say, 100,000—with a dilapidated street railway system, earning a gross income of $125,000, to purchase same for $500,000—property rights, franchises, etc., and equip it with 40 miles of single track and 65 electric cars.

COST OF EQUIPMENT.

Steam Plant (1,500 horse power steam plant):		
Five engines, 250 horse power each, compound condensing, size 16 inches x 32 inches x 42 inches, with wheels weighing 30,000 lbs.	$32,500	
Eight R. T. boilers, 72 inches x 16 feet	9,600	
Jet Condensers	3,000	
Two boiler feed pumps	900	
Steam and exhaust piping	12,000	
Five engine foundations	3,500	
Eight boiler settings	3,200	
Five 30-inch belts	2,000	
Erecting and starting	3,500	
Freight and miscellaneous	2,500	
		$72,700
Electrical plant:		
Five generators, 200 kilowatts, 7,500	$37,500	
Switchboard installation, foundations, etc.	4,000	
		41,500

Building:			
Power station, including stack, traveling crane, etc.....		$25,000	
Car house and repair shop, including tools, etc..........		15,000	
			$40,000
Track construction:			
40 miles girder rail construction, ties 2½ feet centres, 63 lb. rail, etc., $1.15 per foot..........................		$244,880	
Relaying, including paving, etc., at 60 cents per foot....		126,720	
Trucking, hauling, etc...............................		24,000	
Ties, including 10 per cent. of joint ties, 130,000 at 40 cents		52,000	
Ties, including 10 per cent. of joint ties, 15,000 at 70 cents		10,500	
			456,100
Line construction:			
Ten miles iron poles, etc...............................		$75,000	
Ten miles wooden poles, etc...........................		40,000	
			115,000
Car equipment:			
65 electrical equipments at $2,000......................		$130,000	
65 car bodies, 18-foot body, with open ends.............		65,000	
65 trucks at $250.....................................		16,250	
			211,250
Summary:			
Steam plant..................................	$72,700		
Electrical plant..............................	41,500		
Building......................................	40,000		
Track...	456,100		
Line construction.............................	115,000		
Car equipment.................................	211,250		
		$936,550	
Superintendent's and Engineer's work..........	$50,000		
General and miscellaneous.....................	50,000		
		100,000	
		$1,036,550	
Original purchase		500,000	
Total cost re-equipped..................................			$1,536,550
Gross income, say, $350,000.			

Net income, say, 35 per cent., equal to 8 per cent. on cost, on the basis of an investment of about one million and a half of dollars, and from a property which in many instances was hardly earning its fixed charges formerly.

We have here illustrated a practical example of what is being done every day in this country at the present time in the purchase and equipment of street railway systems. In fact, we find a large number of bankers and capitalists giving it their earnest attention as one of the best fields for investment at the present time.

CENTRAL STATION IN CONNECTION WITH ELECTRIC RAILWAY WORK.

We desire to call the attention of central station owners to the profit to be made from the furnishing of power in street railway operation, and also by the combining in smaller towns of the street railway companies and electric light companies. The trouble in most cases in central stations obtaining contracts for power, outside of small roads, has been to convince the railway companies that the electric light station can economically and reliably furnish this power, and we must say that in many cases their fears are well founded. Therefore, it behooves the central station companies to place their generating plants and station, not only for their own business, but for this added business, in such a shape as to remove this objection. There is no reason why electric light stations should not do a large and profitable business in this line as well as in stationary motor work, for the same factor is introduced here and the same reasons why they can safely and profitably furnish this power; if they have a station properly built, and large enough to add this power, that factor is established. If they have a proper station operating force, in many cases this force need not be added to at all. As to what basis this work can be profitably done on, we hesitate to state figures, except in specific cases, but will try to give a general idea of some of them. For many small roads power contracts have been taken at so much per day,

assuming a basis of 100 to 125 miles operated. Such contracts have been at from $3 to $5 per car. The regular basis, in accordance with which most street railway companies make their contracts and desire to base their cost of operation, is the unit of car mile operated; therefore, most contracts are on this basis. This comes down, therefore, to a basis of from three to five cents per car mile; the latter figure we consider excessive, and one which would be only made by any company for temporary necessities. We know of cases where the matter has been carefully considered and the plant properly installed for it, where contracts have been made for between two and a half and two and three-quarters cents per car mile for sixteen-foot cars, on roads with grades not exceeding 1½ to 2 per cent. In this case, and, in fact, in most cases where the closer figures prevail, the railway company furnishes the generators and the station owner furnishes the steam power and all expenses of both steam and electric power due to ordinary wear and tear. A profitable source of investment has been found in the more moderate sized towns of, say, up to 30,000 or 40,000 inhabitants, in the installation of combined electric railway and lighting stations; the companies either equipping new ones or purchasing old street railway systems and dilapidated lighting plants running on an unproductive basis, but which have a good franchise and field for business. Such companies have proved very profitable, as the combining of the operating expenses for railway and lighting station has done much to reduce expenses, and in many cases one manager or superintendent has proved sufficient for the entire system.

What we have tried to prepare here has been, not a paper which will be so attractive to merely read, but in which will be combined a certain amount of data infor-

mation which will be of use in the further consideration of the problems herein outlined, and trusting that, if we have accomplished nothing else, we have led you to a profitable line of thought, it is respectfully submitted.

DISCUSSION.

MR. BURLEIGH: The paper is an exceedingly interesting one to me. I would like to ask what service is rendered by the local lighting company for the three cents per car mile.

MR. FIELD: The actual service is to operate the generators, which the street railway companies should install. I believe that the street railway companies should install their own generators, because I believe that questions will arise about accidents happening to their generators, and the station should only be responsible for ordinary wear and tear—not accidents due to short circuiting, lightning, or other causes. That, I think, is the most satisfactory basis for this kind of business.

MR. BURLEIGH: The loss of an armature, in that case, would be borne by the street railway companies.

MR. FIELD: Yes, sir.

MR. BURLEIGH: Then this three cents per mile is for current?

MR. FIELD: For furnishing the steam and the labor. There are some cases where the current has been contracted for, for four or five cents, temporarily, as in Boston, where the West End Company, owing to delays in building their car house, have had to contract with companies that could not afford to furnish it for any less than four or five cents per car mile.

MR. BURLEIGH: I would like to ask Mr. Field if he advises central station men to attempt the care of overhead lines, the electrical part of the car equipment, etc.

MR. FIELD: In general, I would say no. I think that is the street railway companies' own business. Any street railway company that is running on a proper basis should have an emergency gang take care of their own line. Otherwise, questions are going to arise. I do not believe in a central station manager attempting any more than he has under his direct care now, and that is the running and furnishing of power from his station.

THE CHAIRMAN: We have enjoyed that paper very much; it has proved very interesting, and I regret it was so late when it came up. I think the lesson taught by this sort of experience will result in our taking more time on our programme for the transaction of the business which we are here for, rather than for outside entertainment. We are compelled now to pass over Mr. Field's paper at a time when we would all be benefited by the liberal discussion which I know would take place. But our programme is fixed, gentlemen, and the thing to do is to come as near to carrying it out as we can.

I have a memorandum from Mr. Huntley which says that the Governor-General, who arrived this morning, will receive at four o'clock, at the residence of Sir Donald Smith.

The Convention then adjourned until September 11th, at 10 A. M.

ORDER OF BUSINESS.

FRIDAY, September 11, 1891.

FIFTH SESSION, 10 A. M.

1. Paper, "Some Details of the Care and Management of an Arc Lighting System as Practiced in the 'Municipal,' of St. Louis."
   By JAMES I. AYER, of St. Louis.
2. Paper, "Different Forms of Carbons Used in Arc Lighting."
   By W. C. WARNER, of Chicago.
3. Election of Honorary Members.
4. Executive Session.
5. Report of Secretary.
6. Report of Treasurer.
7. Election, Members of Executive Committee.
8. Next Place of Meeting.

FIFTH SESSION.

The Association met pursuant to adjournment, Friday, September 11th, and was called to order by the President at 10 A. M.

THE PRESIDENT: We will first take up the paper of Mr. J. I. Ayer, entitled "Some Details of the Care and Management of an Arc Lighting System as Practiced in the 'Municipal,' of St. Louis."

SOME DETAILS OF THE CARE AND MANAGEMENT OF AN ARC LIGHTING SYSTEM AS PRACTICED IN THE "MUNICIPAL," OF ST. LOUIS.

As central station men, it seems to me that we should demand of each other as much knowledge of the practice and experience as is practicable to give. In fact, if this Association is to be useful, our meetings should be largely "experience meetings," and the practical experience of those engaged in the development of the lighting and kindred industries, if given liberally at each meeting, would be followed closely by those interested in the production of electrical apparatus and supplies, and would do much to advance the business and improve appliances. Believing that we are here, as central station managers, for mutual improvement and for the free interchange of ideas and experience, I have presumed to present you with a limited, though doubtless dry, outline of the practice which obtains in the central station under the writer's charge.

The station, as designed, has a working capacity of 6,000 arc lights, and is now operating daily 3,500 and about 200 constant current motors. Two thousand of these lights are distributed over an area of sixty square miles, suspended between and from poles fifty and sixty-

five feet in length, at a height of from thirty-five to fifty feet above the roadway, an average distance apart of about 900 feet, and used for street lighting. The motors and about 1,500 lamps are operated for the usual varied service of private consumers. Sixty-nine circuits supply the lamps and motors, containing about 1,200 miles of wire and supported on 12,000 poles.

For generating the current we have six 600 horse power Corliss engines, which drive 300 feet of shafting, from which are driven sixty-five 60 light, and twelve 80 light, 2,000 candle power arc dynamos. The arrangement of the dynamos is such that we have ample room for the care of 85 machines on a floor space of about 100x45 feet, and are able to operate a large number of dynamos with a very limited amount of help. Four boys and one young man of very limited experience care for all the machines during the night, in an entirely satisfactory manner, while a suitable man, with three assistants, give the necessary care to the dynamos during the day.

Thirty-one trimmers, with horses and carts, travel about 500 miles a day to renew the carbons in the street lamps. The average number of lamps to each of these trimmers is sixty-eight. Sixteen trimmers care for the 1,500 commercial lamps. Five inspectors, or troublemen, with carts and horses, care for the lines night and day, answer fire alarms, locate faults and correct minor troubles on the lines. Two day and two night inspectors care for the commercial arc and 2,500 incandescent lamps. A stable of twenty horses, in addition to the forty horses owned by the trimmers and inspectors, is required. The maintenance of sixty vehicles justifies a blacksmith and wagon shop, which, with the stable, require the service of eight men. Two men care for the shafting, and three engineers and four oilers for the engine room. In the boiler house, where there are nine-

teen 300 horse power boilers, there are two pump men, with two assistants, twelve stokers, one boiler cleaner and six coal shovelers. These, together with an average force of thirty-five line and ground men, foremen, chief trimmer, chief inspector, superintendent of lines, storekeeper, repair shop employés, carpenters, clerks, etc., constitute a force of about 170 men. A very large per cent. of these men are called upon to perform duties which are simple, yet, because of their extreme newness, are not thoroughly comprehended by them. To get the best results, each man requires clearly written rules, as few of them as possible, and their rigid enforcement. In all practice this is the wise way to put it; but it is absolutely necessary that it be so with a large force, where many of the men do their work independently and free from the constant supervision of a foreman.

In the room used as an office at the station by the inspectors and foremen are city maps, mounted on boards where the locations of the lamps are indicated by tacks and the circuits by strings. For the central part of the city, where there are many circuits on the same line of poles, each circuit is shown on a separate map of that section. A number of printed slips, which represent a pole with cross arms, indicate the location of the wires on the poles on the different streets traversed by the different circuits. Any change of circuits is noted on a separate blank when the work is ordered, and when completed the maps are corrected to correspond. It takes but a few days for a man to become quite familiar with the circuits, by keeping them so conspicuously placed. In large stations this method of indicating circuits is almost indispensable, and will prove of great value if used in smaller ones.

For testing purposes we have a portable tachometer for indicating speeds, two Thomson indicators for the

engines, a recording steam gauge, two standard ammeters and a voltmeter reading to 5,000 volts for the dynamo room; on each circuit a spring socket for attaching ammeters and a current indicator for indicating the direction the current is flowing through the circuit; near the lightning arresters on the upper floor, a switchboard specially arranged for testing only; a Wheatstone bridge, magneto bells, etc. The engines are indicated once each day.

Evaporation boiler tests are made every month to see that the quality of coal is maintained at the standard. All the circuits are tested four times each day. All live circuits during the day are tested for grounds, and all others for apparent open circuits as well. In addition to this, all circuits are tested while alive by taking volt and ammeter readings simultaneously. The number of miles of wire and number of lamps being known, any material increase in the energy consumed gives evidence of a fault not always easily discovered by other methods. In testing for grounds on circuits not alive, a strong magneto bell is used. For all other testing a battery current of from thirty to fifty volts is used, and the circuit is required to pass at least one ampere to operate an ordinary call bell. When this bell is placed in series with a circuit which has more resistance than will pass this current at the pressure, the circuit is at once inspected and the fault located. In locating the trouble, one side of the bell circuit is connected to the line and the other to earth. The inspector or troubleman carries a similar bell with him, which he connects in series with the earth and lines at various points, until the fault is located. The value of circuit testing with low voltage is keenly appreciated by those who have practiced it. When the circuits are alive, ammeter readings are recorded every two hours, and all readings are from the same instruments. These instruments are arranged so as to be read singly or in series,

and one is used to check on the other. The value of first-class instruments in plants of any size cannot be over-estimated, and should be in daily use in all stations, rather than the makeshifts generally supplied.

The stopping and starting of engines and boilers, pumps, dynamos, circuits, etc., are all recorded on reports made by those in charge of the different departments. Each inspector, trimmer, line foreman, storekeeper, and all heads of departments make daily reports of work done, and time and material used by them. Each trimmer is charged with a certain number of demerits for each fault on his route, such as defective or dirty lamps, broken or dirty globes, carbons used in excess of the required number, etc., and each month prizes are awarded to those having the best records.

The advantage of using vehicles for trimmers for all street lighting work is being recognized. Provide a man with proper appliances and your service will improve. He cannot carry all that he should and walk long distances, nor will he take the same care when he is worn-out with tramping that he otherwise would. We find it desirable for the trimmer to own and care for his own horse, while the company provides a suitable vehicle and harness, which he turns into the stable once a week for inspection, cleaning and repairs, when needed.

We select from our linemen those whom we class as inspectors or troublemen, who are equipped with a light-running cart, with a suitable place for the storage of all tools necessary to use in an emergency. In addition to the special duty required of them during storms or at fires, these men correct all minor troubles reported to the office from various sources. During the first year's operations the average time lost, due to open circuits at night —that is, the average time lost from the time the circuit was opened until it was closed and the lights restored—

was an hour and five minutes, notwithstanding that all circuits are more than ten miles in length. When these troubles occur, it is almost always during a storm, but the conveyances with which they are provided and their thorough knowledge of the circuits enable them to become very expert in locating and correcting troubles. During the past year nearly 15 per cent. of all the calls answered by our troublemen were to correct troubles on the lines of other companies. Because we have wires all over the city, the police, and the public generally, think that all the wires belong to us, and when they discover any trouble with them, are very apt to report the same by telephone to our station. During the entire twenty-four hours there is always one man on duty, ready to answer just such calls and correct the troubles.

All arc lamps, before leaving the station, are placed in a test rack, where they are supplied with a current maintained absolutely constant. Voltmeter readings are noted soon after the lamps have been lighted, when the carbons are about half consumed, and also when they are burned quite short. During the early part of the burning the lamp is adjusted so that the readings, taken at three different points, give an average reading of forty-six volts. In case of double lamps, this work is carried out on both rods. This extreme care in regard to adjustment we regard as absolutely necessary. If a lamp is permitted to consume its carbons, any fault which would not be discovered with a brief test is quite likely to develop. To determine the length of arc by the current and voltage is more likely to result in uniform lamps than where tested by the eye. With ten lamps, adjusted to burn at an average of forty-six volts, with 9.5 amperes, the average number of watts per lamp was 436. Without changing the adjustment of the lamps, the current was increased to 9.8 amperes, and

there was an average consumption of 524 watts per lamp, an increase of 20 per cent. of energy; and by increasing the current to ten amperes, the average number of watts per lamp was 550, the average voltage fifty-eight, the increase above normal being 33 per cent. That means 33 per cent. more coal, 33 per cent. more work at your dynamo, 33 per cent. less capacity in your dynamo, and, probably, 33 per cent. less life in your armature. One is apt to think that the difference between 8.5 and 10 amperes, when supplied to the lamp, is only a difference of 5 or 10 per cent., which is not very serious. This would be true if the lamp were adjusted each time for the ampere current it was to be operated with. To those who have not made this experiment, perhaps, a portion of the mystery as to where the coal goes will be cleared up. By using the ammeter and voltmeter for adjusting the lamps, and then seeing that the circuits are provided with the same ampere current indicated by the same ammeter, one will be apt to bring about like conditions in all lamps; at least, they are more likely to be uniform than if independent ammeters are used on each circuit. By reference to this statement relative to the amount of energy consumed by change of current, it will be easy to see how expensive one or two low lamps would be on a circuit, where the operator, to correct the trouble, supplies them with current enough to make them bright. Of course, it is understood that better service, as well, is obtained by operating the circuits with no more current than that for which the lamps are adjusted. In this connection, I believe, it is proper to again call attention to the well-worn subject of connections. A great deal of time and trouble is spent in soldering joints, and when the lines are led to the lamp they are apt to be poked into the binding posts, held with set screws indifferently tightened, and between these

binding posts and the lamp connections proper there are, perhaps, three or four, if not more, indifferent contacts, all of which look very well in the factory, but are very bad after a few months' service. Hanger-boards should be used which have the line wire soldered to connections which cannot get loose. In our practice we accomplish this by using about eighteen inches of flexible insulated cable, which is soldered to the hanger-board binding posts at the station (cut-out boxes are treated in the same manner), leaving the lineman nothing but an ordinary line joint to make, which can be easily done outside. Where lamps are suspended from the hanger-boards by the hooks which conduct the current, we always insist on some character of second connection being made to the lamp besides this. A simple way to do this is to take some small wire and tie the hook to the loop, in much the same manner as you would with a piece of twine. We have no screw connections anywhere in our circuits, and with a little ingenuity and care, they can be avoided always in arc lighting circuits. By the use of a special socket in each circuit for connecting an ammeter, we are able to take the readings with volt and ammeter, and get a correct indication of the actual consumption of energy on a circuit while in operation. With the data relative to the number of lamps in service and the number of miles and size of wire, we are able to discover any excessive consumption of energy and prevent the development of a series of little faults, which, in a short time, grow to be very serious ones if permitted to continue. Usually these readings are taken on each circuit three times a week, and during the time these observations are made, indicator cards are taken from the engines. From these two sources we get the actual consumption of electrical energy per circuit and per engine. We also get the

indicated horse power. From a set of eleven observations, taken from July 30th to August 28th, at various hours during the night run, the station shows an efficiency between indicated horse power and electrical horse power at dynamo terminals of 74.9 per cent., ranging from 70.3 per cent., the lowest, to 77.5 per cent., the highest efficiency shown. The circuit readings indicate an average consumption of energy per lamp of about six-tenths of an electrical horse power. The average indicated horse power is about eight-tenths per lamp. A good condition of the circuits is maintained constantly, because any neglect in any department is quickly shown by the data obtained from our records. Some months ago, when press of business caused the measurement of circuits to be neglected for a few weeks, the writer discovered an increase of over 10 per cent. in the consumption of fuel, when there should have been a slight decrease. An investigation showed that an accident to an ammeter had caused a false reading, which increased the cost of fuel alone about $16 a day. The difference in the appearance of the lamps was not such as to call forth special comments then by those interested, yet, when the fault was discovered, it was remembered that some seemed to have been burning high for a week or two. On suburban circuits on long loops, it is our practice to place cut-out boxes on the pole where the line branches. This saves a great deal of time in locating troubles; but, let me add that unless a thoroughly watertight and substantial cut-out is used, it will prove more of an annoyance than an advantage. A log of each circuit and dynamo, as well as of engines and boilers, is a very satisfactory and desirable part of the records, and will frequently assist materially in locating troubles and saving expenses.

Throughout the country it is almost the universal

practice to wire for arc lights without cost to the customer. There is no valid reason for this custom, and for more than a year it has been our custom to charge for cost of labor, with the result of reducing expenses more than $600 per month. In every case where lamps are discontinued in the spring, we require a contract for fall and winter service, else the wires are removed when the lamp is taken down. We invariably cut down the line between the house and the pole where the service is discontinued for the season, though it is to be renewed later. To induce annual contracts, a rebate of 5 per cent. is given at the expiration of the year, and is found to work to advantage.

There are very many details of construction, as well as of office work, which could be referred to, if it were not that this paper is too long; but I will be glad to furnish a copy of "general instructions to employees," used in the government of this plant, which refer to and bring out some points of management which are not mentioned here, to those who care for them.

DISCUSSION.

MR. AYER: In order to expedite our business, I will omit reading the paper. The title of it indicates its character. As you all have copies of the paper I think it can be discussed without going through it. I have not made a synopsis of it, or any headings of subjects, still, perhaps, I might make some suggestions in connection with it, as I have something to say that can, perhaps, be brought out better in this way than by waiting until we get into the discussion.

One point I touch on in the beginning, where I say that I think our meetings should be largely "experience meetings." I think you will all agree with me in that statement. The practice we have had here of meeting

in the morning, carrying our meetings along until we get through the programme laid out, results in this: That if there is much discussion of the papers, or much interest developed in the matters that come before you here, you delay other matters, and carry the work over very close to some entertainment, or into the dinner hour, and this has sometimes been very unfortunate. Yesterday a paper on electric railroads was read here by Mr. Field. It was full of interest, and yet, because of the lateness of the hour at which it was presented, many of the members had gone off to take care of other engagements, or to get ready for the excursion on the river, or to get their luncheon; and for that reason the thing was neglected. And yet, we had a paper then from a man who was giving us just the character of information we wanted, and which was thoroughly practical in its statements. It concerned a matter which is of quite as much importance to us as the subject of any of our papers, and contained information which we all want to get at. We want the central station men to say something. We want to have papers emanating from them which are pertinent to their business. That thought has been suggested to me, and, I presume, is in the mind of everyone who comes here for information.

In referring to our station, and in giving you this paper, I have done so with the idea of bringing out, developing and inviting other papers of this nature. I want to say, with reference to this station of ours, that the problem which I had there was different from that of almost any central station man that I know of to-day. It was to start in and build a plant of large capacity, to spend money far in excess of the requirements of the station by the business in sight, and to build a station which still had a very large business to start with. We already had a contract with the City of St. Louis for 2,000

lights, and the prospect was, when the station was first laid out, that it would ultimately absorb other companies —take in a number of smaller stations, as was afterward done; so my instructions were to build as large a station on a given piece of ground, which they handed over to me, as I could, and regardless of what it cost. I was confronted by a problem in that particular which will explain some of the peculiarities of construction which we adopted.

I built a station with a working capacity for 6,000 lights, but when the station was put into operation it started with 2,000 lamps. All the stations throughout the country which are in the hands of our members have, as a rule, grown up from small affairs. They started up in some junk shop or other, with a few dynamos, and grew as the necessities required; and the result is that there has been an enormous amount of patchwork all the way through. But in our station there is nothing of the kind. We had to start off and build something which would be complete in itself, and which was comprehensive enough to take all the work in the near future which was likely to be drawn into it. Since putting the station in operation we have absorbed the other companies, and brought up the output of the station to the number of lights mentioned in the paper. At the time of building this station there was nothing of its character or magnitude in this country. The problem which confronted me, aside from the designing and construction of the station, was the system of management to be adopted, the methods to be applied, the details relative to the management of the men; and it all had to be worked out and put in motion with the wheels at the beginning. The plan that I outlined, the blanks that I made for the government of my men, are those that I am using to-day. I have made but a few minor changes in the

original blanks that were laid out before we had done any work at all in the way of operating. And, while, undoubtedly, we have followed in details many of the practices that have obtained in other central stations, in the management of our men and in the division of the work, I want to say that I was unable, on applying to a number of cities, to get anything to assist me in arranging our blanks or system. It was a thing that could not be found. I have since found, in conversation with central station men who have large plants, that we have thought out the same ways of managing our stations, independently, that we are working on similar lines. In some instances it is peculiar that it is so. One reason for outlining the details of practice at our station is the fact that that has not been done very much, and because I realized the difficulty I had in endeavoring to obtain information. In fact, I did not obtain anything that was of value to me. That is my excuse, in a measure, for going into details of our plan of working, to such an extent, in this paper.

First, I will refer to our method of caring for the street lamps. We have a number of street lamps distributed over a very large area. The city required that our lamps should be supported very high above the streets. The minimum altitude of the lamps is thirty-five feet above the roadway. The city also required that we should suspend them between the poles. They were arbitrary in the matter. In order to get our lamps at that elevation, the shortest pole that we could use was fifty feet in length. In suburban lighting they require the lamps to be fifty feet above the roadway, and they have to be suspended from sixty-five to seventy-foot poles—according to the length of the span. The average distance apart is about 900 feet. I think that we have about 1,500 lamps where the average distance apart is

825 feet. The rest of them, 500 or more, have an average distance of 1,300 feet between the lamps. These are long distances.

In lighting the suburbs, and, in fact, the whole city, we have found the use of a cart and horse very desirable. As stated in the paper, the average number of lamps per trimmer, with a vehicle, is sixty-eight. When one stops and thinks about the work—where lamps are located close together, easy of access, supported by methods which enable the trimmer to get quickly at the lamp; or even supported as mine are, when they are placed so high above the streets—that looks like a small number, because we have, as, doubtless, many others have, some trimmers who care for more than 100 commercial lamps per day. But we have our lamps at this high altitude and it takes a long time to raise and lower them. We are compelled to use a device for raising and lowering—a device which has to be lowered and locked, in order to prevent its being meddled with—and that necessitates each time the unlocking of the device by the trimmer, applying the crank, lowering and raising the lamp; and as the poles are set on the curb line of the streets, and passing vehicles could easily knock off the device, the hoisting device has to be placed high up out of the reach of the sides of wagons, and that necessitates the use of a ladder to get up to the hoisting device. It seemed to me before we went into operation that it would be essential to have something of that sort. We have a cart, modified to suit the requirements, and enabling our trimmers to carry extra globes, extra lamps, rubber clothing, means for keeping the carbons dry, and any number of tools that they wish (and we require them always to carry a few), and to carry the means to enable the trimmer to make any temporary repairs for the purpose of removing any defect or trouble that he may find. We have found

that by furnishing our men with cart and horse (requiring them to furnish the horses) we have been able to employ men for $65 per month who are in every way equal to the men whom we employ for trimming commercial lamps, where they carry a step ladder around the town, at two dollars per day. For $65 per month we find them seeking the position as trimmers. They furnish their own horses—feeding, shoeing and caring for them in every particular—leaving us only to supply them with vehicles and harness. The cost of maintenance for vehicles and harness is not very great. The cost of outfit was about $75 per trimmer. The cost of repairs, and depreciation of harness and vehicles, is about 40 per cent. per annum, as we calculate it; that is, it will cost about 40 per cent. of the investment to keep it up. That thing has been discussed somewhat, and in some other places they have tried the use of carts, and are not altogether pleased with them; but where the conditions are satisfactory, I must say that we find much better results in the care of our lamps in that way than we have ever experienced with the same class of help. With $40 trimmers, such as we have, I doubt if we could get the results that we do in any other manner.

We have a very useful little blank which, I presume, may be advantageously used in many other places. We have printed on it a form of telegraph pole with fifteen cross-arms on it, and ten pins. Although we use no more than eight pins for our work, yet we use other pole lines in carrying our wires over the city, and we keep a record of every pole and wire on those blanks. The location of the pole and the positions of the wires on the pole are indicated on the blank. From the corner of First to Tenth Street, Circuit No. 5 will occupy the two outside pins on the top cross bar, and the side of the street and the name of the street are given, so that by reference to

that diagram at any time we know the exact location of our own and of other people's wires. In laying out new circuits, and in doing addition work, it is a very convenient thing to refer to, and it saves lots of work. It is very convenient, where you have many poles, and especially where you have to run a mixed line and interchange with other companies, to have some such arrangement.

In the care of a station, it is rarely the practice to have anything in the way of instruments, except those furnished by the parent company, and, possibly, sometimes one outside instrument. We all know the utter unreliability of the ordinary commercial device furnished to us as an ammeter by these parent companies, and unless you do accurately know the amount of current, leaks will creep into the plant which I am sure would astonish anyone if he were to go at the matter carefully and measure them. I do not think that there is a station in a town of 20,000 inhabitants and over that can afford not to be provided with a high reading voltmeter (I am now speaking exclusively of, and referring only to, arc line circuits) that will measure the whole difference of potential on your circuits during the operation of them, so that you may know the amount of energy being consumed ; and accurate ammeters are essential, in order to know what that energy is. I have made a point of that in the paper. I will give you a statement of a little test. Until I had made the test, and made the comparison, I could not realize that the difference, or the opportunity for difference, was so great. With ten lamps adjusted to burn an average of forty-six volts, with 9.5 amperes of current, the average number of watts of the ten lamps was 436 per lamp. Now, without changing the adjustment of the lamps in any manner, but simply increasing the current so that the ammeter needle read 9.8 amperes (an in-

crease of 0.3 amperes—and you will find that the indicator furnished by our parent companies will not agree within half an ampere), with an increase of current of only 0.3 of an ampere, the average consumption or increase of watts was 524, or an increase of 20 per cent. in the watts consumed. That was the result of changing only 0.3 of an ampere. When the current was increased so as to give the lamps ten amperes, we had an average voltage of 58 volts per lamp instead of 46—an average of 550 watts per lamp, or an increase of 33 per cent. in the energy consumed. There is a saving equivalent to a very handsome profit on your lamps.

We all know that of ten, in a moderate sized station, some one of the ten will think the lamps are not in good order and will come in and ask : "What is the matter with the lamps? Push them up." The ammeter is found to be all right; still, we give them more energy. Many of our superintendents want to have good lamps, and want to make a good show with them, so they keep their lamps bright in this manner. Now, they will get just as satisfactory a light, and a more even light, by having the lamps properly adjusted and running them on a normal current, as they can possibly get in this manner, and be able to save from thirty-three to fifty per cent. of the energy consumed in those lamps. This is a point that I know a good many of you have looked into, and you have discovered in practice that it is an opportunity for very serious leaks, but I have never heard anyone bring it out before. The matter has never, to my knowledge, been before the Convention, or publicly commented upon. This shows you the necessity of having a good and accurate instrument adapted to your work. Our practice is to take the commercial instruments furnished by the company whose apparatus we use, and then standardize them, regardless of their scale, indicating where

the needle should stand to indicate the currents that our lamps are adjusted for. We use two Weston ammeters as standard instruments. I find it desirable to use two rather than one. We use those almost entirely for standardizing these other instruments which we use in practice. There is something very peculiar about an ammeter. I find that they will run along perfectly accurate, and that two or three instruments will agree exactly for a week or ten days, and then, without any apparent cause, and when working under identically the same conditions, and collected together in series, so as to take the same amount of current, the needle will vary sometimes as much as 0.2 or 0.3 on one instrument. Then we bring in our standard instrument and put it in the series, in order to find out which one of those has changed its adjustment. It is something that we do not attempt to account for, grouped as they are, for this occurs in cases where we have them fastened to a board against a post, and where all the influences surrounding them are the same under all conditions and at all times, and they are not in close proximity to any wires carrying heavy currents, and there is no opportunity that I know of for change, either in condition or position. And yet the change does occur. I think that money expended for good instruments to be used in adjusting lamps and in maintaining the current constant, is money well expended. In operating the large number of lamps that we do, if we had an ammeter on every circuit (as some do) we would have a very variable condition of affairs. Of course, these variations in ammeters would exist. We keep continually two ammeters in series. We have a very convenient plug and socket made for inserting the ammeter quickly in the circuit, so as to get it right in circuit. Our practice is in starting up, as soon as the dynamo is in operation, to insert the plug, and see that the current

is what we desire to show by this instrument. We go through the whole series in that way, and that thing is repeated in our station every two hours during the night and during the day time once an hour. We find it desirable to do this. While we have not much change in load, we have changes in circuit conditions during the night, and the governors are not always responsive to a moderate change of load. You can easily build up your current 0.1, 0.2 or 0.3 of an ampere, and the governor will not always respond. We burn more carbon, and, of course, more coal during that time.

This matter of circuit connection is often a fruitful source of trouble, as well as one of the causes of an immense loss of energy, and is a thing to which we all ought to pay close attention. I know that all central station men now make it a practice to make a solid circuit by making good line joints; but when we let out a lamp, we are very apt to have a binding post there, and we are apt to insert the wire either in the hanger-board, or on the lamp proper, and the man sets up the set-screw, and leaves the lamp hanging there, and then the wire will corrode and a condition will be brought about which will soon so disarrange things that a forty-light dynamo will run only thirty lights. We use hanger-boards for suspending all our lamps, whether inside in commercial use or outside in city use. The hanger-boards are all provided with cut-offs. But before the boards were put into service—not before they were put in service, for we put our plant in operation very hurriedly, and so took our boards as they came from the manufacturer—but shortly subsequent to that—we soldered a short section of flexible insulated cable to the binding post of each hanger-board, and when the man comes along to make a line connection after the hanger-board is put in place, he makes an ordinary line joint. Thus they

get a good, solid, strong connection. The soldering is done in our repair shop or done at the station, where they have time to do it well. Of course, a man cannot do a good job out in the wind and under all the conditions usually existing when he has to solder up a connection of that nature, and where an iron must be used to solder a wire to a binding post. We have all seen cases where cut-outs on a line have soldered joints which had better have been left alone, and even the solder left off. There is often a lot of acid left on so that the wire is corroded in a very short time, or they get a little lump of solder piled up in one corner. The same practice obtains as to all the devices that we put in circuit. In cut-out boxes we use the best flexible insulated cable, so that it may be put in and out many times and leave the connection unimpaired. We have these soldered to the hanger-board binding post at the station. This leaves the lineman nothing but an ordinary line joint to make, which he can do outside easily and well. I cannot say that that is done on all our circuits, because of the hurried way in which the plant was put in operation, and because we put in 1,200 lights at the very outset, and so there is more or less of the old construction which has not been overhauled. But, generally, we have no connections in our stations except solid soldered connections, except where a lamp is connected to the hanger-board. We have a hook hanger and we have also a binding post on this hook on the lamp. We hook the lamp into the hanger-board hook, and solder a short piece of cable which we put in a binding post, and set it with a screw. Thus we get a double connection where we cannot have a solid connection. There is no hanger-board that I have seen, and no method of hanging lamps by hooks, or connecting them by a single connection to a hanger-board, that will not develop trouble in ordinary

practice, but by using the double connection you get very good protection.

I have mentioned in the paper that it is our practice to charge the customer for arc light installations. I am aware that this practice does not generally obtain throughout the country. One of my employees, who came to me from an older company, once told me that I was wrong in attempting this; that the thing could not be carried out; that it would make trouble, and give us bother in endeavoring to collect from or compel customers to pay arc light installations. I maintain that there is no more reason why we should do wiring free than there would be for a gas man to charge nothing for piping a house. There is no more reason why a gas man should pipe a customer's house than there is for our wiring a house free for incandescent lamps. Of course, in the early days, when arc lights were still an experiment, we were anxious to get the thing in a man's house, so that he would try it, hoping that if he liked it he would keep it; and so we did not charge for wiring. And later on the same thing prevailed, and to get a customer started, we were willing to do the wiring, for the sake of getting him converted from the present method of lighting by gas, to the new method of electricity. And so that practice has been followed up, because the precedent had been established. But there is no sense in it—no matter how much you think you cannot get away from it. It is like anything else. If you charge for the wiring there is likely to be an awful kick at first, but it will soon wear away, and men will finally come to recognize it as a correct business principle that you have got to make from some other source the money which you spend in putting in lamps, and that if you are making a fair rate of profit on your lamps, if you have still to add this extra cost of wiring to it, you increase the cost, and

if you place this increased cost of the lamp on the man who keeps the light but for a few months, then you are imposing on the man who keeps his light for a long time. We have effected a saving, or decreased our expenses more than $600 per month, by refusing to put in the lamps free. We make a charge of 35 cents per hour for all labor except that of the foreman, and we charge 40 cents per hour for his time. We also charge for the horse and wagon at the same rate, and we charge from the time the men leave the station until they return. That charge will usually cover the time of connecting it in circuit, and the cost of the minor things which we never take out—in the way of screws, insulators, and such other little things—and perhaps, also the cost of removing the wires. We have another shrinkage there in the scrap wire that comes in, and that may or may not be covered. But in a measure, this charge covers the expense. We make it a point with our customer that we want to own those appliances, that we bear the cost of them, but that we want to charge him for the labor, and we charge for the labor in that way. We do not pay those prices, as you understand;to our linemen. We own our own teams. The horse and wagon is worth $4 a day to us, charging at that rate, and does not cost us anything. I know that there is a good deal of objection made to this plan, and, in fact, the president of our company said that I was taking a wrong stand; but it did not make any difference to me, and after the first few months all objections were gone. Many of our customers require only short service lamps, as from October to the first of January, or, perhaps, through the winter, taking them out in the spring, and we have customers who take lamps for six months in the year only, their business being of such a nature that they do not require them longer. Those people want the lamps every year, but not for all the year,

still they do not want their wires taken out; and so, to save increased expense to them, and to avoid the taking out and putting in of wires, we require them to sign a contract, when the period of service expires, for the succeeding season. Then we leave the wires in, and agree to connect them without cost. But for our own protection we disconnect them entirely from the circuit. We always cut the wires out of the buildings, close the circuit at the pole, and take down the loop leading to it. I am satisfied that it is well worth the cost to do this, for then we are in no danger of burning them up; and by cutting them off, closing up and making a solid circuit, we do not have to look for trouble from cut-out boxes, or other bad contacts, nor do we have trouble. The place where men never think to look for trouble is in these dead wires. They forget them. While this costs little money, I think it saves a little in the end.

I do not know whether I have touched on all the points that I wanted to, and which are covered by this paper, but if there are any other points of interest to you, I hope you will bring them up.

The President: Are there any remarks upon this paper of Mr. Ayer's?

Mr. Nicholls: I am very glad that Mr. Ayer dwelt so strongly upon the inadvisability of central station companies doing free wiring. Of course, I am not at the present time interested in arc lighting, but when we commenced incandescent lighting we were advised to do free wiring. I took the ground that it would be unbusiness-like; that it would be on the principle of those people who sell tea at so much a pound and give a chromo with it. I thought that we would not develop so rapidly if we did that as we have, fortunately, done. We have done our own wiring, for the reason that in our city we have not had the advantage of first-

class construction companies upon whose, work we could depend. There was some little wiring done and it was unsatisfactory, and we started in to do it ourselves, as a matter of self-protection. We have connected up—I do not remember the total number—but in the last fifteen months we have wired for upwards of 12,000 lights, and we have endeavored to make it as near cost as possible, so as not to make it burdensome to the consumer. Still, I find that we have made a very fair percentage of profit, which has gone to defray the many items of expense that would otherwise be chargeable to general expense account. I think that if there could be some understanding that free wiring should not be done it would help the electrical industries, because when we started to charge we were met with the statement that this town and that town were doing free wiring, and we ought to do it the same way. It is simply a matter of business. If we charge for wiring, we are going to get it out of them in some other way. If we are going to lose ten, fifteen, twenty thousand dollars a year for wire, we have got to make it up in our meter charges in some other way.

MR. FRANCISCO: There is one feature of this business that has been overlooked. It is very convenient to carry out Mr. Nicholls' plan, and I fully concur in his views—provided there is only one company in the place. But if you have two or three different companies, an entirely different plan of operation is inaugurated at once. If you charge for wiring, the other company, nine times out of ten, will put the charge for wiring at less, or the people will go to one company and get their price, and then to another company and get their price, and so on, and the man who does it for the least money gets the job every time. Of course, the true way is to charge for wiring, but with competition and two companies I have

found it is utterly impossible to charge for wiring, because the other companies would do it for nothing. Of course, you cannot get parties to take your lights when they can get the same thing without paying for it.

In regard to Mr. Ayer's paper, I have been very much interested in his remarks. They have been very instructive to me, because I have had the pleasure of examining Mr. Ayer's station all through. The good book says you should not envy, but it seemed to me I could not help feeling very peculiarly in going through that station. It is complete in every respect, and there are a great many things there that are instructive, and every electric light man should have the chance to examine and, if he could, adopt them, because they are practical, and based on practical working. Now, I hope that we can, in time, adopt some plan or some arrangement in regard to this very question of free wiring, because it is a very serious difficulty; there is no question about that. In many stations renewals are furnished free. I furnished them myself. I made no charge for renewals on lamps. Of course it is a dead loss to the company, and the charge should be made for renewals, the same as for wiring and those things, and I trust that in time we may be able to get some other basis or plan of operation whereby we can carry this out, and have our return for that service, just the same as we do for all other service.

Mr. Nicholls: I am glad Mr. Francisco referred to the question of competition. I think it is better to sell your product at a lower price—to give a discount—rather than to give something for nothing. You then know exactly what you are doing and exactly what you can afford to do. If you do free wiring, I maintain that you have no right to charge it up to capital account; you ought to charge it to expense account. When once you wire a customer's premises, he has you at his mercy;

he can tell you to take your wires out. Whereas, if you meet competition by saying we will give you 10, 15, or 20 per cent. discount, then if you have a row with your customer you simply lose his custom, but you are at no financial loss in the matter as regards the actual expenditure of capital, and I think that is a far more reasonable way of meeting competition—to sell the product at lower prices.

MR. FRANCISCO: I would say that I always charge free wiring to expense, and not to construction, or anything else. It is a dead loss.

MR. SEELY: Three of the largest companies in New York started in to do free wiring. I think they spent half a million dollars before they realized the fact that it was an expensive luxury. It cost them, on an average, about three dollars a light to put in. They finally reached a combination whereby they agreed to charge the customer actual cost. Some enterprising gentlemen put the cost down to a dollar and a half a light. His opponent kept his price stiff at three dollars. The three dollar man did not get the business. Finally, the wiring got down again to about a dollar a light. But I do not agree with the gentlemen about the account to which wiring should be charged. In some large buildings there is $10,000 worth of wire alone. If you make a contract with a man to wire a building, you make a contract with him to either buy that wire at the expiration of the contract, or to remove it. You will find that companies have spent thousands of dollars in wiring large buildings, and it would be nonsense to charge that to expense.

I would like to ask Mr. Ayer about a point in relation to the adjustment of the arc lamp. It appears that Mr. Ayer adjusts the ammeter up to the arc lamp. In other words, he establishes a zero point and adjusts his

lamp to that zero point. It may be five, ten or fifteen amperes; it may be one ampere. I do not believe that an arc lamp can be accurately adjusted, taking a large plant such as Mr. Ayer has. It is a pretty hard matter to get all those lamps nicely adjusted so that they take a certain amount of current. We have found in calibrating our meters—we have sent one to an institute of technology for a calibration, and have sent another to a first-class instrument maker—that they would vary. We would write to those gentlemen and they would say that they had gone through the work carefully; probably it had got out of adjustment in shipping. What electric light people are suffering for at the present time is accurate instruments—something that will not get out of order.

MR. AYER: I would like to say to Mr. Seely, about the inability to accurately adjust arc lamps in a large station, that I think we are better able to do it in a large station than in a small one. I have two young men whom I do not think can be made competent to adjust an arc lamp until they have about two months' practice. I do not think anyone can. I have two young men I give that work to and they have become very expert at it. It is very remarkable how quickly they will detect a flaw in a lamp, and locate the cause of it. And it is the same with carbons; it requires practice. In a large station we are better able to do that than it can be done anywhere else. But there is no question that you can get a better adjustment of a lamp by having a constant current maintained on the circuit, and arriving at what the average length of arc shall be by the use of a voltmeter, rather than judging it by your eye. If the lamp is in proper condition you will find that it has a normal voltage. There is a range between the hissing and the flaming point, which, when adjusted by a voltmeter, will bring the lamp where it belongs. But you will frequently adjust a lamp

by your eye, or judge it by the flaming and hissing point, and find that it is either too low or too high. You will find that when you have a lamp that is working defectively from some mechanical trouble you do not detect that without the instrument. You do not know what the length of the arc is—what voltage is consumed. This is the result of my experience in the matter. We have it under the best conditions, where we handle a number of lamps a day—fifteen or twenty lamps going through our repair shops, being overhauled and repaired. That number of lamps passing through the hands of my own men every day, they have become, as I say, very expert, and they are accurate in arriving at results. By contrast, however, you might mention a manufacturing company. I know that when my lamps were sent to me the parent company stated that they were in good adjustment to hang up on the circuit. Unfortunately—or fortunately, rather—I had been connected with a parent company prior to building that station, and as the lamps came in I had them taken out and cleaned up and then reassembled and tested, to see where the faults were, and adjusted. I found about 10 per cent. of them that would not have burned at all if they had been hung up, and 3½ per cent. that would have opened the circuit; yet it was not apparent in the lamp. But the young men whom they have had put them through a series of tests. Those lamps had all been, as they thought, adjusted. They just went along and looked at them. The men who did that were earning a dollar or a dollar and a half a day. They never saw the lamps afterward, and knew very little of them, anyway. Now, taking their experience of it, one would say that their method of adjusting would not amount to very much, and that the adjustment of arc lamps was not a

very practicable thing. But my experience is that it is a very practicable thing, and can be arrived at very closely; but it takes time, and you must take one or two of your station men, and insist upon their doing it. The way I have insisted on it is to have a lamp burn eight hours, compelling them to go through that whole thing during the whole period of the consumption of the carbon. It costs a little money, but the money is saved in the end. It does not cost half so much to burn a lamp all day, and supply it with carbons, as to put that lamp into service, and have the defects develop after it has been hung up. Take a double carbon lamp; it will burn all right. Try it on the other side; it will burn all right. In an hour it will go out. By this method of testing you will discover the cause of that. I use boys in this work eighteen or nineteen years old. They are paid $35 or $40 a month for that character of work. I keep sifting them through. Ultimately, I think I am going to have some bright boys. It is just like making rules and having systems. If you make a rule you want to enforce it. They used to think lamp adjustment was fun; but I insisted on their working around, applying the voltmeter and the ammeter. That is a point upon which there is no danger of laying too much stress.

MR. ORFORD: I should like to say a few words about this matter. If Mr. Ayer has any trouble with his governor, the best thing to do is to get a better one. I should think at this time—

MR. AYER: I have a most satisfactory governor, sir; it gives me no trouble. You have to put an accurate, delicately adjusted ammeter on any dynamo. I know of no governor that will hold its place under all conditions. If you would indicate such a one to me I would like to have you do so.

MR. ORFORD: I will not indicate it; but they must

be made; there is no reason why they cannot be made. I have been operating arc lamps for seven or eight years, and I have had various types of arc machines, and I know there are some of them, as Mr. Smith said the other day, on which the only governor is a big load. I think it is a very crude way of running a station to trust to the machine without a governor. It is really going to the same practice as taking the governor out of the engine. Nobody would think of setting up a locomotive or a stationary engine without setting up a good governor, and, in a great many instances, the highest price will be paid for an engine having a good regulating governor; and the same thing can undoubtedly be done with the arc machines. I suppose the fact that people do not look out for the best governor is evidence that they are satisfied with what they have. I am not saying this for the purpose of advertising anyone's dynamo—I have been accused of that at times—but it is because I am somewhat peculiar on that point. I know there are dynamos in existence to-day which, if running one light, will show it is running ten amperes. Take the Weston. You put forty lights on that machine and it will show ten amperes. I know the regulating devices have to be carefully looked to, but when once placed in position, they give no trouble. That is my experience in seven years.

The same thing may be said of an arc lamp. An arc lamp, to my mind, requires only one adjustment. I have had arc lamps in stores for six years, and they have never been touched. The only thing they have had done to them has been the trimming. You bring those lamps into the station and if they do not burn as well as the average lamp I will take a back seat. I think I can say, without being egotistical, that I have had the credit of having as good lamps as can be shown anywhere. I

certainly know that an arc lamp can be constructed, which, having once been adjusted for whatever current you intend maintaining, will burn correctly if you maintain that current.

With reference to this opposition which is continually cropping up. When we started into the incandescent business we thought the wisest thing we could do would be to go to the customers, get as good a price as we could, and ask them for as small an amount as possible to begin with. Their gas fixtures were all in the stores. We had to say something to them to get them to accept the electric light in preference to gas, and we thought it would not be a very good method to begin by telling them that they had to pay for the wire. Consequently, we took the ground that the smaller the expense to the customer in the first place, the more customers we would be likely to get. We recognized the fact that we were going to spend a considerable amount of money in wiring stores, and we thought it would be a permanent business. We have had the incandescent light in stores for four years. We have had very good prices. The cost of the installation is a small amount when you spread it over four, or, perhaps, forty years. I see no deterioration of the material, and the amount of money necessary to keep it in good condition is very small indeed. The question of renewals is one about which we have debated very considerably. The only advantage which I can see in the customer buying his own lamps would be that we could sell them in a bunch and have done with it, whereas we supply them one or two at a time, as required. The disadvantage of the customer buying his lamps has appeared to us to be that some of them might burn the lamps as long as they would burn, and in that way it would not be very creditable to us to have to compete with very good gas.

Now, then, if the Convention can help us in any way to kill competition in our town, we would like to get some assistance. The competition which has been threatened us has been threatened by a member of the Association, and if the Association can do anything to keep one of its members from coming into competition with another, we should be glad of its assistance.

MR. SCOTT: I feel very grateful to Mr. Ayer for his talk; it is just the kind of talk I came here to listen to. We do not have arc lights, but we have incandescent lights. I gather a vast amount of information from what he says, and I understand well the importance he attaches to standardizing a voltmeter and an ammeter by an instrument not made by the parent company. We have standardized voltmeters and ammeters made by the parent company, and the voltmeters and ammeters on the switchboard are apparently all right, according to that, but in testing otherwise I found that one street loop having an amperage of about 7.7, running on the series system, showed when I put it on one machine by itself, eight amperes by that ammeter, and on another machine eleven amperes by that ammeter. I transferred the ammeter to the other machine, and I found the trouble was with the instrument itself. In testing the exciters of the direct current machine I found one was giving 98 volts, another 115, another 140. There is evidently something wrong about that; and I did that only by getting a Weston current voltmeter and putting it on in place of the voltmeters which we had in the station. I think it is of great importance to everybody. Our men are told to test and standardize the voltmeter and amperemeter every hour.

In regard to free wiring, we have stopped that. We did it because the gas company, which had lowered its rates from $2 to $1.60, in order to compete with us, finding

that that was not sufficient, had offered to pipe all large stores and residences free. With small stores they threw in fixtures. We immediately started free wiring. We told people that the gas company knew they had an inferior article or they would not have done that; because, since 1856, every man had had to pay for every foot of pipe from his meter to his burner. The increase of consumption of electric light has not varied a particle since they began with free piping and we began charging for wiring, and I think that, while sometimes it may be a loss of capital for a few months, in the end it is good business management. But when you have a good article, and are determined to keep it good, and another man is trying to cut your throat, it is poor policy to spend your capital in trying to cut his throat. I would rather stand aside, and try to convince the public that I have a better article, and cannot come down to any such rates as those. When we started, we, of course, wired free in stores. We paid the cost of installation of 300 lamps in four blocks on one of the principal streets, which was $696. That was two and a half years ago. Those lamps have paid us $300 a month during that time. I believe that would be a good investment. At the end of the year we charged that off to profit and loss. But after firmly establishing the company, I think that wiring should be charged for. It must become a rule in future, to be adopted by the electric light companies just as it used to be by the gas companies, and just as it still is by the water companies.

Dr. Louis Bell: With reference to what was said by Mr. Orford in relation to the governor, I have frequently heard the same remark made casually, and I must say that from that standpoint we ought to congratulate the makers of such apparatus from the bottom of our hearts; because I can assure the members of the

Association that no such result can be obtained by the best scientific instruments, made and adjusted with the utmost care, kept in the laboratory, used only by skilled men. I leave it to you how likely it is that such results can really be obtained in practice. Take the best laboratory instruments and they will get out of adjustment with the most skillful use, and when they are subjected to a degree of care which could not be even approxi mated in the most refined commercial work. I think the cause of the error that is so frequently made in ascribing exceedingly fine regulation to commercial apparatus is due to the fact that it is not sensitive enough to show more variation. I have tested, first and last, in the laboratory a good many commercial instruments. I find that a good many are excellent for rough work. But the needle of a sensitive ammeter will sway through several divisions, while the indicator on the commercial instrument will not move at all. I have seen a delicate ammeter put on an arc light circuit, and then the regulator of the machine was fiddled with and seesawed with until it ought to have changed the current by a number of per cent. As a matter of fact, the commercial meter showed small changes; the accurate instrument big changes. And even those accurate instruments have to be standardized very frequently, to get good results from them. There are to-day no ammeters and voltmeters suitable for portable use that can go without watching. There are very excellent ones—fine instruments—but they want to be looked after. I am very strongly reminded, in speaking of the commercial regulator that keeps absolutely x amperes flow over the line all the time, of the gentleman we all know whose watch has not lost one-tenth of a second in two years, and of the other gentlemen who takes pride in the fact that his family clock still keeps excellent

time, as he assures you after comparison with the sun, and yet has not been cleaned for twenty years—a most marvelous piece of mechanism. I think we are very much inclined to overlook small discrepancies sometimes, when the general results seem in the rough to be all right.

MR. ORFORD: Anyone familiar with an arc light station knows that we do not use Thomson's reflecting galvanometer to take readings by. There is no use in using an ammeter which fluctuates backward and forward. We use a Weston dead beat. The simplest way that I know of to keep your ammeters and voltmeters in good order is to have a pair of them. If you have a pair of ampere-meters, and put one in the station for every evening, so that you can take a test once a month, that ampere-meter will stand you a dozen years. If it is not possible to make an ammeter that will stand such a test as that, our friend Mr. Weston's life has been spent in vain, I should say. Everyone knows the difficulty of keeping in circuit a voltmeter that is only required on the incandescent work. A voltmeter being in a circuit is quite unnecessary, in my opinion, for incandescent work. If you can get a Howell lamp regulator, you will find that that regulator will answer your purpose. Of course, the action of the voltmeter is principally on the lamp that is burned with it. They supply an excellent lamp, and you recalibrate that lamp once a week, if you desire. I have had four years' experience with them. I assume that the Howell indicator will get out a little, but it is a very small amount. But you can take your lamp, regulate it, and calibrate it to suit yourself; you can do it once a night if you like; we find that once a week is quite ample. Of course, our readings are taken from the mains that go up the street. We take our readings from the mains occasion-

ally with one of Weston's voltmeters. With that method, we are able to find out whether our station instruments are pretty nearly accurate. I do not wish for a moment to be understood as saying that there is no variation in our current; the governor will not move unless there is a change in speed. It is the same with the regulation of an arc lamp. Any one familiar with the regulation of the arc will know that the current does not stand steady. It goes backward and forward, up and down. You can limit it by devices which they have supplied, and keep it moving but a very small amount. The arc lamp is not such a sensitive instrument that it will go out because there is a variation of ten per cent., even in your current. I think you can vary the current ten per cent., and there is not a man in the room who can tell the difference. I can give you an instance. I happened to be running a machine which is really a sixty-five light machine. It is a Brush machine. I was competing with the Thomson-Houston. I gave them pretty good competition, and I dropped the current. I had seventy-five lights on the machine. I dropped my current down, and there was not a person who knew anything about it. In fact, a couple of years afterward, one of the lamps which I had had in use happened to get into the hands of one of my former competitors and he got it on his regular ten ampere circuit, and he was surprised at the action of the lamp, and wondered why that lamp had changed so much since I had it. He was not aware that I was running eight amperes. My competitor was running ten. Consequently, you see that the difference of a quarter of an ampere, even, in a lamp is of no moment.

MR. SEELY: I believe the point made by Mr. Ayer is that in large stations running an ampere more or less it is a question of coal supply only, and not a ques-

tion of reducing the light. I think that seven-eighths of an ampere makes a difference in profit of $75 in the coal. Those are the points he desired to bring out. A man said to me that he could reduce his amperes to nominally nothing and still give light. I would like to know how you can hold your voltage if you cut down your amperes. I have seen some stations running five amperes for a 2,000 candle power lamp. If you gentlemen desire to go and see a ten, an eight and a half, or a seven ampere lamp, and say that there is no difference, I would like to have you do it. I have had the pleasure of visiting nearly all the prominent stations throughout the United States in the past two months, and I could see a difference in the light.

MR. ORFORD: I do not advocate the running down of the current, but I say that a small amount of reduction cannot be perceived in a lamp. Nevertheless, I do not advocate it. But I do say that such machines are in existence, and in every day operation, and if any one will come to Bridgeport he can see them for himself. We go over our machines every night, take the plug out, put the ammeter in circuit, and see if it is all right. Night after night, week after week, and month after month, those machines will run, and run correctly. Of course, the needle will vibrate a little, high or low. I certainly would not advocate any attempt to give your customers any more than you are obliged to give, but it is your salvation to give them satisfactory lights. But as to the question of the volume of current passing into the lights, I have been in Montreal, and I declare that I could not tell to-day whether they are burning a 1,000 candle power lamp or a 2,000 candle power lamp. I think that gentlemen who have made this arc light business a study will admit that it is very often difficult to tell whether a lamp

is operated by a seven, or a six-eighths, or a ten ampere current.

THE PRESIDENT: If there is no further discussion on Mr. Ayer's paper, I will call upon Mr. Nicholls to read the paper of Mr. Warner, on Different Forms of Carbon Used in Arc Lighting.

MR. NICHOLLS: Considering the lateness of the hour and the fact that we are to have an executive session which will be likely to consume considerable time, I would suggest that Mr. Warner's paper be taken as read. I think that every member of the Association has received a copy and has read it. It is a short, terse and practical paper, but it is a paper that, so far as I can see, calls for very little discussion. And so, with your permission, I move that Mr. Warner's paper be taken as read.

MR. ARMSTRONG: I second the motion.

(The motion was agreed to.)

DIFFERENT FORMS OF CARBONS USED IN ARC LIGHTING.

In the period just preceding the introduction of the arc electric lighting commercially, experimenters and inventors had brought forward numerous plans, ideas and theories regarding the size, form, and manner of using carbons, and in view of the fact that no reasonably cheap method of generating the electric current then existed, a surprising amount of attention was given to the subject, and the developments of the art, shown by many publications, form no small part of our history of arc lighting.

It is not my purpose to dwell at length upon the history of carbons generally, but rather to touch lightly on some of the more notable forms known at the time of which I am speaking, and then to pass on to a consideration of the utility and practical results obtained with the different forms of carbons in use at the present time, paying special attention to the matter of form and size as affecting the results.

The form of a cylinder or pencil, it is noteworthy, was that used by Sir Humphrey Davy in his earliest experiments, and he even devised special holders or clamps to retain the carbon pencils in alignment and facilitate their adjustment with a view of maintaining a constant and steady light.

Archereau subsequently adopted the pencil form of carbon and used it in his lamp now so justly considered as the first practical arc lamp; it does not appear, however, that he turned his attention particularly to the matter of form.

Wright and others stand on record as experimenters with carbon discs brought edge to edge and made to rotate as they were consumed; and the combination of a disc placed on edge above a vertical pencil of carbon was also tried at this early date.

Wallace and Farmer made use of broad, flat plates of carbon, placed in a vertical plane, one above the other, the arc forming between the edges as they were drawn apart, and shifting back and forth from one end of the plates to the other. Another inventor, at about this same date, placed flat plates of carbon side by side with the arc forming at the upper edges of the plates and an intervening insulation of some refractory material, the arc forming at the upper edges of the plates and gradually consuming them.

Jablochoff in 1876 introduced his well-known electric candle, a form of arc lamp in which cylindrical carbons are employed placed in a vertical position and held separated by a thin filling of refractory insulating material.

Now, when we look back at the work of these early inventors, and consider what special object they had in mind in making their experiments, it is at once apparent that it was continuity of action, and it stands on record that they met with fair success, so far as the feature is concerned, some of the lamps being capable of twenty hours burning without attention.

In 1874 Mathias Day produced an arc lamp in which two cylindrical pencils were placed in the upper holders and two in the lower holders, the upper ones occupying a plane with the lower and directly over them. Here the avowed object of the invention was to secure long-continued operation of the light without requiring attention, and it is certain that he accomplished it in a very creditable and ingenious manner.

Coming, now, to the time of the commercial birth of

arc electric lighting, we find Jablochoff in the lead, closely followed by Brush and Weston, each making use of the cylindrical form of carbon pencil and turning their attention most assiduously to the feature of continuity of operation, the first move being an increase in length of the pencils. Carré, a French manufacturer, at this time, became prominent as a maker of carbons, and succeeded in producing pencils about seven-sixteenths inch in diameter, and thirty-two inches in length, and it was thought by the use of lamps of suitable length these long carbon pencils could be advantageously used when long-continued burning was a necessity, but, owing to the difficulties encountered in the manufacture, and also trouble in maintaining proper alignment for the carbons, a length of twenty-two inches was soon settled upon as most practicable and convenient.

As the business increased and the demands became better understood, the inventors again essayed to solve the problem of continuity of action, but, in many cases, such attempts were but returns to old forms and methods, and did not result in any practical advance.

Various forms of double carbon lamps were introduced, and, for a time, these were thought to be the only practical and commercially successful way out of the difficulty, but more recent developments have shown a far simpler and better way, and one, furthermore, that cannot fail to impress the practical electrical engineer. I refer to the simple expedient of using a carbon pencil of five-eighths inch diameter, fourteen inches in length, in an ordinary single carbon lamp. It is true that this is not new, and that carbon pencils of such size, or even greater, were tried long ago; nevertheless, the introduction of carbons of this size and form has a very great bearing on the commercial side of the situation; but before going into that matter I wish to say a few

words regarding the lighting efficiency of five-eighths inch carbons.

Having noticed that the question had been raised as to whether these carbons would give as much light for a given expenditure of electrical energy as would those of one inch diameter, I tried the following experiments:

Two single lamps were connected in series in an arc circuit, one being supplied with five-eighths inch carbons, fourteen inches in length, the other with one-half inch carbons, twelve inches in length. Around each lamp was branched a voltmeter indicating the voltage. The lamps were then adjusted until they had the same voltage, and as current was, of necessity, the same in each, it was a safe conclusion that equal amounts of energy were being supplied. Photometric comparison of the two lights was then made at the horizontal, and at many different angles, above and below, with the result that no perceptible difference could be found in the power of the lights. During the tests the current was maintained as constant as practicable, and care was taken to base the comparison on an average deduced from a large number of readings.

Now, while this matter of lighting efficiency is one that concerns the people operating electric plants, it does not interest them to the extent that other features upon which I have yet to touch may, as I happen to know that the management of lighting stations look long and lovingly on any plan that seems to give good promise of reducing running expenses. To begin with, there is the difference in first cost between a single and a double carbon lamp, and the difference in the expense for repairs and attendance, these items varying, of course, with the different lighting systems. Still another important saving is in the cost of carbons, the cost for a given number of hours run being fully thirty per cent. greater with one-half inch than with five-eighths inch carbons. There is

the further important saving in the breakage of globes which often is caused by the sudden shifting of the arc in the double carbon lamp. Twin carbons, consisting of two cylindrical pencils placed parallel and in close juxtaposition to each other, and connected by a web throughout their entire length, have of late been introduced, and when in use, the arc alternates between the different pencils comprising the upper and lower twin carbons. A test of these carbons, made principally with a view of determining the life and lighting quality, gave unsatisfactory results in the following particulars. It was observed that the duration of burning for a given weight of material was not nearly equal to that which could be obtained with the same amount of material in a single cylindrical pencil. This I attribute to the more rapid disintegration of the twin carbon, resulting from the very frequent heating and cooling of each member. Indeed, this is found to be true of two carbons where arranged as in the Day lamp, or so that the arc alternates frequently beween the different sets ; and there is quite a noticeable difference in consumption of carbon for a given duration of lighting as compared with an ordinary single carbon of the same diameter burning without interruption.

Another undesirable feature of twin carbons is the shadow cast by the non-burning members, which, while it may not be disagreeably noticeable when the lamp is provided with an open globe, most certainly operates to reduce the total output of light.

It may be argued that the main item of expense in the manufacture of carbons does not lie in the material, and the fact that five-eighths inch carbons cost so little more than one-half inch would bear out such a position, and I have merely mentioned the fact of the rapid disintegration and burning away of the twin carbons by way of explanation.

MR. FRANCISCO: I have a resolution which I desire to introduce in regard to some business that was not completed yesterday. I will not take time to discuss the matter at all:

"*Resolved*, That the report of the Committee on Safe Wiring, and rules adopted, be printed immediately, and a copy mailed to each central station and insurance association in the United States."

DR. MASON: It is essential that the words, "as amended," should be introduced there. We do not adopt the rules as reported by the committee.

(The President, at the request of Dr. Mason, read the resolution again.)

DR. MASON: Pardon me; we cannot let that go on record in that way.

MR. FRANCISCO: I do not quite understand the Doctor.

DR. MASON: That does not express anything. I am sure you don't want it to go that way.

MR. ARMSTRONG: Why not say, "*Resolved*, That the rules for safe wiring, adopted by the Convention, be at once printed and sent?"

MR. FRANCISCO: I accept the suggestion.

(The motion was carried.)

MR. FRANCISCO: On behalf of the Executive Committee, I wish to offer a motion, and I will not take time in discussing it. I move that Sir William Dawson, Frank R. Redpath and Professor Henry T. Bovey be made honorary members of this Association, under the recommendation of the committee.

DR. MASON: I second the motion most heartily, and will not take time in making remarks which spring to my lips.

MR. SEELY: Before that motion is put, I offer you,

sir, a name to be attached to that resolution—Mr. Thomas D. Lockwood.

DR. MASON: It cannot be, except coming through the Executive Committee.

MR. SEELY: I would like to know, then, when these names were presented to the Executive Committee, and when this Executive Committee was called to consider them. I shall most assuredly insist on the committee assembling and passing upon Mr. Lockwood's name. Mr. Lockwood is a gentleman who has followed us around at our meetings, who is an eminent electrician, who is a clever fellow, and I think it would be an honor, not only to Mr. Lockwood, but to this Association, to have him as an honorary member. It would also be an honor to the Association to have the previous gentlemen become honorary members. I simply suggest that Mr. Lockwood's name be brought before the Executive Committee before this vote is taken.

MR. FRANCISCO: A large proportion of the Executive Committee are here, and they can answer for themselves without delay. I, as one member, will be in favor of the motion of Mr. Seely.

MR. AYER: I would like to express the same sentiments, as a member of the Executive Committee.

MR. BURLEIGH: I agree with Mr. Seely about the desirability of making Mr. Lockwood an honorary member, and it can be, and undoubtedly will be, done. But I ask for the question on the names already presented.

(The motion was put and carried.)

THE PRESIDENT: I declare Sir William Dawson, Frank R. Redpath and Professor Henry T. Bovey honorary members of this Association. (Applause.) The Secretary is instructed to at once advise the gentlemen of our action in this particular.

Mr. Seely: I represent one of the Executive Committee, and four of the Executive Committee have said that they were perfectly willing to vote for Mr. Lockwood, and I ask the President to call a meeting of the Executive Committee this afternoon for a special meeting of this Association. I now move you that a special meeting of this Association be called this afternoon, to consider a motion that will be brought before the body.

The President: It has been moved and seconded that a special meeting be called this afternoon.

Mr. Armstrong: It that necessary? When we adjourn now, after our Executive Meeting, why do we need to assemble? If it is necessary, I suppose the members of the Executive Committee are here and they can be called together during the public meeting, before the Executive Session comes to order, and pass on this name. That motion might be determined, and in the Executive Session it can be done just as well.

Mr. Nicholls: I rise to a point of order. In what manner do the by-laws provide for the calling of a meeting of the Executive Committee? Have you to give due notice, or can you call together those who happen to be about?

The President: There is nothing in the Constitution other than that it can be called by the Chair.

Mr. Ayer: It seems to me that this special meeting is essential unless we can determine this matter in some way. If we continue our session here we must have a meeting of the Executive Committee before our adjournment. This matter of calling a special meeting is only a matter of form.

Mr. Armstrong: I suggest that a meeting of the Executive Committee be called when this public meeting is adjourned, and in a second they can recommend

the gentlemen, and in the Executive Session we can elect him.

THE PRESIDENT: Mr. Seely, will you withdraw your motion?

MR. SEELY: Mr. President, I will withdraw my motion.

MR. NICHOLLS: I move that the general meeting now adjourn, to be called together again in, say, ten minutes.

(The motion was carried.)

THE PRESIDENT: The general meeting is adjourned.

After a few moments' intermission the general meeting was again called to order, and Mr. Seely rose and said:

I have the honor of presenting to the Association the name of Mr. Thomas D. Lockwood, of Boston, as an honorary member. At the last meeting of the Executive Board of this Association he was unanimously endorsed.

MR. BURLEIGH: It gives me a great deal of pleasure, Mr. President, to second Mr. Seely's motion.

(The motion was carried, and Mr. Lockwood was declared to be an honorary member.)

(Colonel Stevenson, of Montreal, here came into the room, and was invited to a seat near the President.)

THE PRESIDENT: Gentlemen, I have the honor of presenting one of Montreal's most noble citizens. Coming here in June, a stranger, the first man I met was Colonel Stevenson. The aid and encouragement that he gave to members of the Executive Committee is a matter that each and every one of us fully appreciates, and for which we shall always be grateful. No one has been more considerate of our welfare, or has added more to the enjoyment of our visit, than our good friend, Colonel Stevenson.

COLONEL STEVENSON: I had no idea, Mr. President, that I would be called upon to say anything; I came in

simply to listen to the discussion which I supposed was going on. However, I fully appreciate the kindly way in which you speak of any little service that I have been able to render this Association or any of its members. Of course, we did not exactly understand what it meant when the committee first came, but we are curious people, like you Yankees on the other side, so we asked. As soon as we learned what this Electric Light Association was, we saw it was our duty to do everything possible in the City of Montreal to make this visit as agreeable to those who came as it would be profitable and instructive to our own citizens. I think, thus far, the Convention has been a decided success in every way, so far as I can see, and I only hope you will carry away with you such a good opinion of the city as will induce you to return some day not very far distant. Of course, we cannot hope that all your meetings will be held in the City of Montreal, but we will be very glad when the Association sees its way clear to taking another trip across the border. You seem to be enjoying yourselves just as well under good Queen Victoria as you would under Benjamin Harrison, President of the United States. The fact is, it does both you and us good. I do not suppose there is any idea of any organic union between the people of the two countries, yet there can be a feeling of unity, a fraternal feeling, which, I think, can do good in a great many ways.

You have not yet seen the full force of our water power. We have in Victoria Square a fountain in which we have a four inch pipe, and it throws a column of water from the ordinary supply pipes to a height of over 100 feet. This afternoon the water will be turned on there at three o'clock, and I think it will repay you to go and see it. (Applause.)

The Convention then went into Executive Session.

EXECUTIVE SESSION.

THE PRESIDENT: The first consideration in Executive Session will be the report of the Secretary and Treasurer.

SECRETARY'S REPORT.

The condition of the Association, so far as its membership goes, is much stronger and more encouraging than it was at the opening of the year. Many individual memberships have been dropped since the adoption of the present constitution, owing to the fact that memberships are under it very largely represented by corporations and firms, instead of individuals. Notwithstanding this fact, quite a large addition has been made to the membership since the last report of your Secretary, and the general interest in the affairs and work of the Association has very greatly increased, owing to the active agitation concerning the very important benefits arising from a membership and the representative character of the Society.

According to the last Secretary's report, the number of members who had paid dues for 1891 was as follows: Active members, 65; associate members, 107; making a total of 172.

The present membership stands as follows: Active members, 78; associate members, 142; making a total of 220 members.

I beg to say, in connection with the total membership of this Association, that it is far from what it should be, and far from what it might be, in view of the immense possibilities for the diffusion of valuable

information within its grasp. Our active membership list, especially, should be largely increased, and could be so, by making an active membership a valuable consideration, and worth considerably more than the annual dues amount to, in the way of practical information furnished during the course of the year. I would suggest that the Committee on Data be increased in its membership, and that the collection and distribution among our members of important facts, figures and details, relating to the furnishing of light, heat and power, be carried out systematically, persistently and without fear or favor, throughout the year. There is a vast field here for good work, and I consider it the most important work that the Association has to do.

MR. BURLEIGH: I move that the report be received and filed and spread upon the minutes.

(The motion was carried.)

Mr. Beane then submitted the Treasurer's report, as follows:

REPORT OF TREASURER.

This report is made from April 1st, dating from my appointment to office, until July 1st, our fiscal year dating from January to July and July to January of each year.

The report is based upon the books of the Association and on the Trial Balance of the Auditor, on April 17th, and on my Trial Balance of July 1st.

The operations of the Treasurer as regards receipts are indicated by Schedule "A," the total receipts being $1,265.00.

Total disbursements amount to $1,387.62; making the disbursements $122.62 over the receipts for that period. The proof of this is contained in the following:

Balance in the Bank April 17th, indicated by the

Auditor's Trial Balance, was \$1,373.15; Balance in Bank July 1st, indicated by Trial Balance, \$1,122.02; Cash on hand July 1st, exclusive of Bank Balance, \$128.51; total of cash on hand July 1st, \$1,250.53; which total is \$122.62 less than the amount on hand April 17th, proving the difference between the receipts and disbursements as indicated by the report.

The assets of the Association on July 1st consist of: Cash in Bank, \$1,122.02; Cash on hand, exclusive of Bank Balance, \$128.51; Value of Furniture Account charged with \$214.15.

The assets were further increased by payment of the Committee on Exhibits of moneys disbursed, and their account is Schedule "B."

Respectfully submitted,

(Signed) JOHN W. BEANE.

MR. SEELY: I move that this paper be referred to the Finance Committee.

(The motion was agreed to.)

DR. MASON: May I be permitted to present to you certain minutes and a resolution? I will read them:

"The National Electric Light Association, assembled in Montreal, at the close of its session, desires to put upon record its appreciation of the distinguished honor shown it by the Dominion of Canada, in the presence of His Excellency, Lord Stanley, of Preston, Governor-General of the Dominion;

"Of the large hearted hospitality of the City of Montreal, evidenced by many graceful acts, official and individual;

"Of the tireless industry of the Citizens' Executive Committee, whose efforts have carried to completion the most successful meeting in the history of this body;

"Of the grand work done by the Committee on

Exhibits, issuing in an exhibition of rare educational value, calculated to develop a larger appreciation of the flexibility of electricity, and its wide adaptation to human needs;

"Of the gracious liberality of McGill College, which has lent the great dignity of its name and the personal influence and labor of its officials to the success of our meetings;

"To the Press of this city, whose extensive and fair reports of our meetings have extended our influence;

"To the railway companies, for their liberal reduction in fares; and to the Windsor Hotel management, where, as guests, we have found a home;

"*Resolved*, That the above minutes be placed on the records of this Association, and a certified copy thereof be sent to the various bodies mentioned."

(The minutes and resolution were unanimously adopted by a rising vote.)

THE PRESIDENT: The next in order is the election of members of the Executive Committee in place of J. J. Burleigh, of New Jersey; A. M. Robertson, of Minnesota, and D. W. Rollins, of Colorado.

MR. SEELY: With the permission of the Chair, before you proceed to the election of those officers, I would like to say that I do not believe that, as a general rule, the active members of this Association know just what arrangements have been made relating to this electrical exhibition; in other words, what proportion this Association receives of the receipts. The exhibitors were to raise a fund sufficient to pay the rental and running expenses of the exhibition during the week. I had the honor of being elected Treasurer of that fund, and am pleased to state that nearly all the money has been paid to the Treasurer that was to be paid for space. I

desire to state that after the Exhibition closes the money will be divided in the following manner:

Exhibitors will retain one-half of the gate receipts, and divide that *pro rata* among themselves. The remaining one-half will go into the treasury of the Association. I desire to read off the amounts of money received at the gate.

We took in $303 on the opening night. The estimated number present was about 3,000. A great many complimentaries had been given out. The receipts of Tuesday afternoon and night were $428.75. Wednesday afternoon and evening the receipts were $303.45, 3,000 persons being estimated to be present. Thursday afternoon and evening the receipts were $664.19—a most agreeable increase, which we all know to what to attribute.

I may be asked why we have had some 15,000 people in this Rink during the past week, and have only received $1,699.38 up to last evening. We have been extremely liberal with our complimentaries. We do not come here to make any money in exhibiting this electrical apparatus; we simply wish to pay our expenses.

MR. NICHOLLS: I have listened to this last statement with a great deal of interest, and although I represent a firm that is exhibiting in the Rink, it is the first I have heard of the arrangement made for the division of the money taken at the gate. I think, however, that every exhibitor has felt so pleased with the success of the Exhibition, and has the interest of the Association so much at heart, that, no matter what ideas exhibitors may have entertained previous to the holding of the Exhibition, their ideas have been so modified through the success of the Exhibition that they will feel in a position to be altogether liberal with the Association. I think it is of interest to us that the future work of the

Association should go forward, that publications of value to us all as members should be liberally circulated, and this could not be done unless the Association had the nucleus of a reserve fund in hand; and, if it meets with the approbation of the other exhibitors, I may say, on my part, representing my own company, that I would be pleased to waive our share of the fifty per cent. of the receipts. (Applause.)

THE PRESIDENT: Are you ready to take up the election of new members of the Executive Committee, in place of J. J. Burleigh, A. M. Robertson and E. W. Rollins?

DR. MASON: I venture to put these names in nomination for members of the Executive Committee for the ensuing term.

MR. BURLEIGH: With Dr. Mason's permission, and yours, sir, I beg leave to withdraw my name from nomination at this time. You have honored me with two terms, covering a period of eighteen months. I appreciate the honor very much, but I think those honors should go round.

MR. ORFORD: I beg to nominate for one of the vacancies A. M. Young, of Waterbury, Connecticut.

(It was agreed that the name of A. M. Young be put in nomination.)

MR. FRANCISCO: I beg to nominate Judge Armstrong, of Camden, New Jersey.

(Seconded by Mr. Seely.)

JUDGE ARMSTRONG: I appreciate that; but I was going to say this, and, if I am right, it would not be quite the proper thing to elect me. Mr. Burleigh has attended regularly, as I understand, the meetings of the Executive Committee, and he has done his duty there. We have too few who do that; out of the three whose terms expire only one is present and he seeks to decline.

It seems to me that if you want to put in any others it would be proper to fill the other places, and retain Mr. Burleigh, and for that reason I desire to withdraw my name from nomination, so that Mr. Burleigh may be elected.

MR. BURLEIGH: Judge Armstrong is very kind, indeed, but I am particularly anxious to be relieved, and that Mr. Young should be my successor.

MR. FRANCISCO: Do I understand that Judge Armstrong refuses to have his name used?

MR. ARMSTRONG: There are three nominated.

MR. FRANCISCO: I would say simply that in correspondence with Mr. Rollins and Mr. Robertson they have expressed themselves to the effect that it was utterly impossible for them to take any part in the proceedings of the Association, on account of their residing at so great a distance, and I would nominate M. D. Law as a member of the Executive Committee.

(The motion was seconded by Mr. Seely, and carried.)

(Judge Armstrong nominated Mr. Nicholls, of Toronto.)

DR. MASON: I made the motion which I made a few moments ago in obedience to a suggestion which would doubtless approve itself to all here. If these gentlemen in Minneapolis and Denver desire to be relieved on account of their inability to attend to their duties, I beg to withdraw them. That will leave three names in nomination—Mr. Law, Mr. Young and Mr. Nicholls. I move you, sir, that the nominations be now closed.

MR. NICHOLLS: While I appreciate very highly the honor paid me, I think you should remember that this is the National Electric Light Association. I have always taken as great an interest in the Association as if I really had the right to accept such a position as you

have now offered; but so long as it is the National Electric Light Association, I think that some gentleman from the other side ought to be placed in nomination.

MR. SEELY: I move that we proceed to ballot for nominations.

(The motion was carried.)

DR. MASON: I move that the Secretary be instructed to cast the ballot of the Association for the gentlemen now in nomination.

(The motion was carried, and the Secretary cast the ballot of the Association, as directed.)

THE PRESIDENT: Mr. Frederic Nicholls, Mr. M. D. Law and Mr. A. M. Young are elected Executive Committeemen of the third class.

MR. SEELY: In offering this resolution, I deem it my duty to make a little statement. When we started with the Exhibition, a gentleman came to us unasked—Mr. Gulick—and offered us his services free, to arrange the details for attending to exhibitors. Consequently, I now, with the permission of the Chairman, offer the following resolution:

Resolved, That a vote of thanks be tendered Mr. James I. Gulick, for his efficient and successful management of the Exhibition now being held under the auspices of this Association, the largest ever held on this continent; and that the Secretary be directed to have this resolution engrossed and presented to Mr. Gulick.

(The resolution was seconded by Mr. Armstrong, and adopted.)

MR. SEELY: I move that a vote of thanks be also extended to Mr. Luther Stieringer.

DR. MASON: I second that, because Mr. Stieringer is a quiet gentlemen who does not appear, but who does

an enormous amount of work, the witness of his associates being taken.

(The motion was carried.)

DR. MASON: Now, Mr. President, I venture, with some hesitation, to give notice that, at the next meeting of the Association, I will offer the following amendment to the constitution: That in the first article, for the word "National," the word International be substituted. I can only give the notice at this meeting, as, according to the Constitution, we must wait six months before acting. I do this because I wish to broaden the field of operations of this body. I do it because I wish to take away any occasion for such remarks as we have heard from our honored member from Toronto. I wish to do it so that when we come to Montreal again with this Association I may feel at home in another and different sense from that in which they have made us so. I give notice that I shall present that amendment six months hence, if I am permitted to be present at the meeting.

MR. FRANCISCO: I would like to inquire if Mr. Corriveau's name——

DR. MASON: Mr. President, I call attention to the fact that in these resolutions we mention no single name. If we had commenced to do that, we should have kept you no end of time. But we did mention the committee of which Mr. Corriveau is a member.

THE PRESIDENT: The next thing in order is the naming of the place of the next meeting.

DR. MASON: I have no special personal interest in going to any one place, but I did agree, at the request of two gentlemen, Mr. John W. Ryckman and Mr. J. B. Platt, representing electric light interests in Georgia, to present their request to the Association that it would hold its next session with them. I present their request,

with the assurance that if you go to Augusta you will receive a warm welcome, ample hospitality, and will gratify the people of that section of the country very much.

MR. AYER: I would like to say that the two gentlemen whose names have been mentioned had quite an extended conversation with me relative to going there, and they stated to me that they were peculiarly well situated for caring for the Convention. They have a permanent exhibition building, and they will do what they can to have a fine electrical exhibition in the event of the Association selecting their city for the next meeting.

MR. MORRISON: I have never yet been able to find out why the Association should not have its next meeting in Buffalo, except that we want to get rid of the idea of having the winter meetings at the home of the retiring president. The proper place for this Association to meet is St. Louis. I am sure that I have discussed this matter more than any other man in this Association with the different members, and I have had at least twenty-five or thirty of the active members say to me, "We want to go to St. Louis." A gentleman told me ten minutes ago that he wanted to go there to see that station. Now, I do not want the Association to go to St. Louis because they have got a good station, because I do not come here to talk shop. If there is going to be any dispute about where this meeting is to take place, I think we ought to compromise the matter by having it in Buffalo. I am informed that the hotel accommodations in St. Louis are reasonably good. That has always been one of the great things we have had to kick about at these meetings. I have only heard two men kick about the Windsor since we have been here, and I do do not think they have kicked very hard.

Mr. Seely: I move that the Association hold its next meeting at St. Louis.

The President: Gentlemen, the name of Buffalo has been suggested as the place of meeting. If you will come to Buffalo, we will do the best we can for you. We cannot treat you as you have been treated in Montreal—no other town can do it. You will find our people as are all the people in the United States, and if you consent to come to my home you will receive the hospitality of everybody there, and we will try to make it as successful a meeting as this has been.

Dr. Mason: I am familiar with certain hotels in St. Louis, and, barring the Windsor, I do not know of a hotel in North America where I have received better treatment than at a hotel in St. Louis. I want to ask Mr. Ayer if it is possible for us to engage, in either of the best hotels in St. Louis, rooms for such a number as would attend this Convention.

Mr. Ayer: I think it is very doubtful. That is a question I was going to bring up in connection with this matter. We have a number of small hotels scattered around in the neighborhood that can undoubtedly take care of you, but we could not possibly arrange to accommodate all at the first class hotels, and we would have to go several blocks to find a suitable place for holding the meetings. It is possible that one of the hotels might have such a place. We have been growing rapidly recently, and the hotels have not grown with the town. I feel that Mr. Morrison's suggestion of breaking up this custom of going to the home of the retiring president is not of such a serious nature that it need interfere in the selection of a proper place to go to. I see nothing wrong about it, especially if the home of the president is in a city where we can find accommodation. Mr. Huntley says that Buffalo will treat us as everybody else does,

and as all Americans will. I think it is time to call a halt on this extensive social enjoyment; this long programme of entertainment which has been tacked on to our business meetings is entirely out of place. We all enjoy it, but that is not what we come here for. We find when we finish that we have not done half what we intended. I meet men in the corridor who say, "I want to have a talk with you." Of fifty who have said that, not five have had a talk. We have all had that experience. And all this is aside from the burden and imposition, I might say, on the hosts. I am heartily in favor of having a resolution passed agreeing to decline any character of entertainment at the hands of the municipality where our meetings may be held. If you go to St. Louis, I trust that you will not pass this resolution at this time. But, in my opinion, it is not wise to take the Association to St. Louis at this time, although, personally, nothing would give me greater pleasure than to have you go. When St. Louis is in better shape to entertain you, then we want you to come. I want to offer as a substitute that the City of Buffalo be designated as the place of meeting of this Association at our next regular Convention, and to incorporate with that that all entertainments on the part of the municipality or of private corporations be declined.

JUDGE ARMSTRONG: I appreciate all that has been said about entertainments, but I should be very sorry to see the Association pass any such resolution. But I would be very glad to have it understood that all invitations should go to the Executive Committee, so that the matter could be arranged quietly. We can easily take care of them in the Executive Committee without saying anything about it. But, so far as that is concerned, you can have your enjoyments without letting them interfere with your business. I have been at Conventions

where there has been no entertainment at all, and this Convention has been better attended than any of those. Business men will attend first to business, no matter what the entertainment is.

As to St. Louis and Buffalo, if it is desirable to go to the West, why not go to Denver or Minneapolis, though perhaps it would be too cold in Minneapolis next spring.

MR. NICHOLLS: I second the resolution that the next Convention meet at St. Louis. I have been there on different occasions, but I never happened to strike the Southern Hotel at a time when it would not hold a great many more people than were in it.

MR. MORRISON: How many members have you lost from the West because the last few meetings have been in the East?

THE PRESIDENT: About twenty-three, I think.

MR. MORRISON: What is the proportion of members East of Buffalo, and what West of Buffalo?

THE PRESIDENT: About 70 per cent. East.

MR. MORRISON: If some of our friends in Denver and other places have never shown up at the meetings of the Executive Committee, whilst I would not object to this Association meeting at Minneapolis, I do not see why 70 per cent. of us should break our necks to accommodate the other 30 per cent.

MR. SEELY: To expedite matters, I withdraw my motion that the Convention meet at St. Louis.

MR. FRANCISCO: Do I understand Mr. Ayer's resolution was to go to Buffalo or simply to make these changes in regard to entertainments?

MR. AYER: I will separate them. I move that Buffalo be selected as the place for the next meeting.

(The motion to hold the next meeting in Buffalo was carried.)

Mr. Morrison: Would it be in order to pass a resolution on the lines discussed a few moments ago by Mr. Ayer with respect to banquets and entertainments?

The President: Let me make a suggestion, Mr. Morrison. Inasmuch as we are in Montreal, it would be in very bad taste to propose any such resolution as that.

Judge Armstrong: Let it be generally understood that all invitations shall come to the Executive Committee, and not here.

Mr. Foote: Mr. President, may I have the privilege of making a remark? I think, perhaps, I can serve you somewhat by passing my own observation upon this Convention. You all know that I have been in a position to judge of the meaning, of the worth and effect of a Convention. It goes without saying that, if all the entertainments that this Association has received at its last four Conventions were rolled into one, it would not more than equal what it has received at this meeting. Notwithstanding that fact, I believe the attendance upon the sessions of the Convention will average as well as those of any meeting we have ever held. I believe that the papers that have been presented here are, in quality, in ability, in material presented, in the method of presentation, equal to any that the Association has ever had. I say the same with respect to the value of the discussions. I will go one step further and say that I believe that the practical suggestions that have been brought out by the discussion of these papers, if properly gathered together and presented for future use in printed form, will show greater value than any that have ever been made to the Association. I have seen men come to these Conventions who have never taken part until now, and I have heard their remarks commented upon as being the most valuable contribution that you have had.

With regard to your membership, I will explain that up to the first of this year there had been a good deal of what we may term dead wood carried in the membership. In the year 1891 we went into existence under a new constitution. Taking advantage of that, I dropped all the members, and when your records are looked over for 1891 you will find that only those have been carried forward as members who have paid their dues for 1891. So that you have to-day a membership without dead wood, and it has influence and prestige.

With regard to the central station people represented here, I find there are forty-nine central station men present. If I am correct in my recollection, the largest vote of central station men ever recorded was forty-eight. That was at Cape May, when you had the exciting topic of the Constitution on hand, and the whips were all out to get everybody in, and some gentlemen, whose names I saw on the rolls here as representing one or more companies, very judiciously paid the membership for all the companies they were interested in, and that was seven or eight. So that built up the membership at Cape May. I think that if every gentleman attending this Convention had registered every company in which he had an interest, that you would find right here a larger central station interest than has ever before been presented at a Convention.

I am very glad, gentleman, to give you this *resumé* of my observation of your meetings. I think now the Association has reached the point where it has got over many of the difficulties which it has contended with in the past, and I see no reason why the Association should not, from this time forward, acquire prestige and influence, and make itself, as it is surely destined to be, the leading Association of America.

MR. SEELY: I regret to say that I omitted from the

vote of thanks the name of Mr. Allen R. Foote, who came to us and offered his services, and I move that this Convention extend a vote of thanks to Mr. Allen R. Foote for his services.

THE PRESIDENT: Gentlemen, it is with a great deal of pleasure that I offer this resolution. I feel, personally, under a great many obligations to Mr. Allen R. Foote. He has given us a great deal of assistance, and has been ever ready, during months preceding this, to help us. His advice has been freely received and acted upon. Without Mr. Foote in the organization, I do not know what we would do. I take again great pleasure in publicly, and at the present time, thanking him for what he has done.

(The Convention then adjourned.)

THE EXHIBITION.

At 8 P. M., Monday, September 7th, the time appointed for the opening of the International Electrical Exhibition, Victoria Skating Rink was literally packed with people, young and old, male and female. The interior was profusely decorated with the flags and the coats of arms of all nations, and streamers from the centre of the roof down to the sides of the hall.

A few minutes later, General Barney, Manager of the Exhibition, accompanied by the officers of the Association and a number of ladies and gentlemen, came out into the directors' box. In a few cordial words General Barney announced that the time had come to open the Exhibition, and called upon Mr. J. I. Gulick, the Chairman of the Committee on Exhibits of the Association, to say a few words.

Mr. Gulick gave a little history of the electrical exhibitions held under the auspices of the Association which have grown from a few scattered exhibits into the present magnificent exhibition—international in its character, and only limited in its scope by the boundaries of electrical knowledge of the day. Mr. Gulick said some very nice things about Canada and Canada's aid in the formation of electrical knowledge, and concluded by calling upon Sir Donald Smith to open the Exhibition.

Sir Donald spoke of the great progress that had been made in electrical knowledge. What had been accomplished they could see in the present Exhibition, which also served to point out to them what might be accomplished in this department of science. The Association

had done much for it, was doing much and would continue to do more. They did it, not for their own country, not for Canada, but for all mankind, who would be benefited by their exertions. Canadians should be grateful for the present visit of the Association, with its great educational stimulus. After a few words descriptive of the good that would come of strengthening the fraternal bond existing between the United States and Canada by the present and similar visits, Sir Donald formally declared the Exhibition open.

General Barney then introduced the little daughter of Professor Henry T. Bovey.

The young lady touched a button and a second later there was a whir of machinery. Faster and faster it grew, until the air was filled with its cheerful hum. Then, when a sufficient current had been generated, a second button was touched and the gloom of the gas was driven away, and a dazzling light—the light of the great modern illuminator, electricity—replaced it. People gazed in wonder, and wonder well they might, for it was a picture of transcendant beauty that the touch of that little button created.

Myriads of lights were there. Lights big and little, each striving to outshine the other; lights great and small, of divers shades and colors, blazed away and turned the darkness of the night into a dazzling light that almost put to shame the glorious light of the departed day.

The attendance was very large. Every seat in the commodious galleries was occupied, while the floor was jammed, making it almost impossible to move from one place to another, except as the crowd itself willed. Fully four thousand people visited the hall during the night, and there were probably three thousand in the building at any time between 8.15 and 9.30.

On Thursday morning, Lord Stanley, of Preston, Governor-General, accompanied by Lord Kilcoursie and the Hon. Mr. Rice, of the British Legation at Washington, honored the Exhibition with a visit. The party was shown the details of the Exhibition by Professor Bovey, President Huntley, and a few others of the important officers of the meeting. Lord Stanley investigated the Exhibition very thoroughly, and created a very pleasant impression by the intelligent interest he displayed in electrical matters.

The power for operating the machinery, of which there was some 300 horse power available, was brought from McGill University, one-half a mile away, thus exhibiting, practically, the electrical transmission of power from a distance in large units.

The Exhibition was open afternoon and evening, from the evening of the 7th of September to that of the 16th of September, inclusive, and was visited by thousands of the citizens of Montreal and neighboring towns.

Following is a list of the exhibitors :

Eureka Tempered Copper Company, North East, Pa.
Chas. A. Schieren & Company, New York.
Standard Underground Cable Company, Pittsburgh, Pa.
W. J. Johnston Company, Ltd., New York.
Standard Electrical Time Company, New Haven, Conn.
Standard Paint Company, New York.
Fort Wayne Electric Company, Ft. Wayne, Ind.
Electrical Engineering and Supply Company, Syracuse, N. Y.
Eugene F. Phillips Electrical Works, Ltd., Montreal, Can.
Felten & Guilleaume, Coln, Germany.
International Okonite Company, New York.
Weston Electrical Instrument Company, Newark, N. J.
The Johns-Pratt Company, Hartford, Conn.
The Ball Electric Light Company, Toronto, Can.
Electrical Engineer, New York.
Interior Conduit and Insulation Company, New York.
Robert Mitchell & Company, Montreal, Can.

Thomson-Houston International Electric Company, Boston, Mass.
Toronto Construction and Electrical Supply Company, Toronto, Can.
H. Ward Leonard, New York.
Dominion Wire Manufacturing Company, Montreal, Can.
T. W. Ness, Montreal, Can.
Edison General Electric Company, New York.
Norwich Insulated Wire Company, New York.
Excelsior Electric Company, Boston, Mass.
Canadian Electrical Construction, Manufacturing and Supply Company, Montreal.
Russell Electric Company, Boston, Mass.
Electric Power, New York.
McGill University, Montreal, Can.
American Phonograph Company, Toronto, Can.
New York Insulated Wire Company, New York.
La Boiteaux Motor and Fan Company, Cincinnati, O.
The E. S. Greeley & Company, New York.
Ferracute Machine Company, Bridgeton, N. J.
Phœnix Glass Company, New York.
Delaware Hard Fibre Company, Wilmington, Del.
Heisler Electric Company, Philadelphia, Pa.
Louis A. Walsh, New York.
Jewell Belting Company, Hartford, Conn.
Hart & Hegeman, Hartford, Conn.
Consolidated Electric Manufacturing Company, Boston, Mass.
Bernstein Electric Company, Boston, Mass.
Western Electric Company, New York.

The Canadian Pacific Railway Company had a telegraph office in one corner of the hall for the convenience of visitors.

COMMITTEE ON EXHIBITS.

James I. Gulick, Chairman.
Frank R. Redpath,
Frederic Nicholls,
John Carroll,
S. C. Stevenson,
M. D. Barr,
W. A. Johnson,
Prof. John Cox,
Prof. H. T. Bovey,
John Kennedy,
A. J. Corriveau,
A. A. Dion,
W. J. Morrison,
C. H. Barney.

ENTERTAINMENTS.

The City of Montreal will ever be remembered by the electrical visitors for the large-hearted hospitality of its citizens. Outside of Convention hours the visitors, particularly those who had brought their wives, were entertained with garden parties, dinner parties, receptions and drives. The complete programme, in respect to entertainments, was not only carried out as before announced, but was added to and several additional receptions and dinner parties were given. Prof. Henry T. Bovey and his charming wife made life-long friends of all who met them, and the delightful garden parties given by Mrs. Molson and Mrs. Redpath on their beautiful lawns were particularly enjoyed by the visitors from the United States, who here met with some English touches of a social nature as pretty as they were novel. The reception at McGill University, Tuesday night, was an event of special note and importance, and was most largely attended.

A reception was held at the magnificent home of Sir Donald A. Smith in honor of the Governor-General, Lord Stanley, Thursday afternoon, from 4 to 6.30. Several ladies and gentlemen who were detained by the excursion down the Lachine Rapids, although late at this reception, were most courteously received by Sir Donald and Lord Stanley, the former personally showing them through his beautiful gallery of valuable paintings and room of rare Japanese ware.

The trip down the Rapids, the firemen's drill, the water pressure exhibit, the most attractive drive over the

city and around the mountains, the lacrosse match and the sail up the Richelieu river, were all highly enjoyed and the electrical visitors brought many pleasant memories of those events away with them.

THE BANQUET.

A banquet was tendered to the visitors by the citizens of Montreal, and nearly 400 gentlemen participated, Sir Donald A. Smith presiding, with Lord Stanley and President Huntley on his right and left. A number of good speeches were delivered, speaking of the most kindly feeling that existed between the two countries. On behalf of the Association, Mr. T. C. Martin presented a phonograph to Professor Bovey, and President Huntley was overwhelmed with the gift of a handsome ebony gavel with gold mountings, his name appearing on it in beautiful letters. Professor Bovey made the presentation speech.

Toasts were responded to by Lord Stanley, President Huntley, United States Consul Knapp, Sir Wm. Dawson, Mayor McShane, Geo. M. Phelps, Thos. D. Lockwood, J. Carroll, A. J. Corriveau and others.

WILLARD L. CANDEE, }
H. DURANT CHEEVER, } Managers.

GEO. T. MANSON,
General Superintendent.

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